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METEOROLOGY

CONSIDERED

IN ITS CONNEXION WITH

ASTRONOMY, CLIMATE,

AND THE

GEOGRAPHICAL DISTRIBUTION

OF

ANIMALS AND PLANTS,

EQUALLY AS WITH

THE SEASONS AND CHANGES OF THE WEATHER.

VIANA · BIBLIOTHECA · PUBLICA

BY

PATRICK MURPHY,

AUTHOR OF THE "RUDIMENTS OF THE PRIMARY FORCES OF GRAVITY, MAGNETISM, AND ELECTRICITY IN THEIR AGENCY ON THE HEAVENLY BODIES."
"THE ANATOMY OF THE SEASONS, &c."

" Il est des vérités à qu'il ne manque, pour être accréditées, que d'être annoncées par des hommes heureux."—*Schulz.*

C'est au fond de l'examen que se trouve la science et la vérité, L'or se ramasse au fond des creusets."—*Helvetius.*

LONDON:

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PREFACE.

As FEW who have turned their attention to meteorology are ignorant of its extensive relations with science and the general interests of society, it were superfluous, in this place, to enter into a detail of these relations. And if in addition we take into account that it was only by discoveries in meteorology, the solution of the grand problem of science, viz. that of the true theory of the world, could have been at any time arrived at: instead of detracting from the importance of this science in other respects, it thus comes forward invested with additional claims, and a higher title to our consideration, than all the others.

And having in the following pages, as I trust, sufficiently shown the truth of these assumptions,

it will be sufficient for me at present to refer to them: but aware, however correct the views there taken, or the principles laid down in reference to the sources of planetary movement, temperature, and the other local phenomena of the seasons and weather, may be, or however important in their relations with the interests of society;—that without co-operation, on the part of the public, in order to give them effect, they cannot possibly be attended with any beneficial or useful result: and consequently that, in its present stage, the affair of giving their utility to these discoveries, is not yet begun. With the view of rendering them as generally operative as possible, by the formation of a Meteorological Society, I have taken occasion in more than one part of the work, to call attention to this subject; fully sensible of the nullity of any thing that has been done, unless it be followed up by something of the kind. And if in the event of being successful, and that, as being identified with the country, Englishmen of a future day, may, possibly, turn to these discoveries with feelings of pride and exultation:—what more appropriate or honour-

able record could those of the present day leave to future times, as to the reception afforded them at the period of their being made, than the one here proposed; having, as it would be sure to have, from its utility, the countenance and support of all good men on its side. For, as to the individual whose name happens to be associated with these discoveries,—as personal considerations have had but little to do in the devoting his time and attention in the manner he has done to these subjects, as proved by the, to him, severe pecuniary losses which, to the present, it has entailed on him. Did he for a moment suppose that his appearing in the business, could, in any way, operate in retarding the accomplishment of the good work proposed, he would at once add that of suppressing his connexion with these discoveries, to the other sacrifices already made by him. He, however, hopes that a more elevated sentiment will be allowed to operate on the occasion, than any thing so low and unworthy as that alluded to; and that, should it prove disagreeable,—in the magnitude of the object proposed, the individual may be overlooked and lost sight of. It is more

than probable, indeed, that his perseverance in the course which has led to these results, had been less; but that he was impressed with the idea, whether erroneous or otherwise, that if discoveries of the nature of these announced were ever to be made,—notwithstanding all that were contributed by others, it could only have been by means of *individual* application and industry: as none other could have embraced and combined in it to the same extent the necessary elements of collecting, combining, and digesting the various facts and circumstances connected with them as a whole, in order eventually to succeed.

For, in a case such as this, where at the outset, or when first taken up by the author, all was obscurity; and where, consequently, commencing in darkness, and thence advancing gradually and by almost imperceptible degrees into light, the transit could not by possibility have been sudden; but, even under the most favourable circumstances, must have been the work of time; and one determined more by accident than by talent in the result. And thus it is that the works successively published by

the author, on the subject, in 1830,—1834, and the present, will, on examination, be found to mark the different and succeeding stages of inquiry, which, as he trusts, has finally terminated in a manner so advantageous to science.

And as, where the interests of society are at stake, the object may be allowed to justify the having recourse to means in order to effect it, which under different circumstances—however innocent—might appear rather humiliating and ludicrous:—thus, after the manner of the celebrated Tull, the father of the drill or horse-hoeing system of husbandry, in inviting his readers to allow themselves to be *prevailed on* to give it a trial;—the author is disposed—though not exactly in the attitude of the Spaniard, and with tears in his eyes!—to beg of the reader to take the trouble calmly to examine the merits of the present theory of meteorology, in its connexion with astronomy, &c. before he makes up his mind on the subject. For, as observed by a German writer, "though it requires but little wit to be of an opinion now, which all the world were of twenty years ago; the reverse of this is rather dif-

ferent; as it bespeaks no slight superiority to be of a sentiment new, which the rest of the world will not be of before twenty years to come." And as it is while things appear to be yet doubtful, that superiority is sure to manifest itself; and that when all are disposed to concur, individual support loses much of its value. Thus perhaps, it is, at present, in regard to the theory here presented to the public:—for if right, as it is sure finally to succeed, those who are the first to see and admit its correctness, are likely thereby to acquire to themselves an enviable celebrity; and such—as a similar contingency cannot occur a second time—as wealth could not procure. Besides, when it is considered that nothing is permanent but TRUTH; as Time, all omnipotent in other respects, changes nothing in reference to the *nature* of *things;* and consequently, where error exists, though *of one thousand years* standing, it is still what it was at first; and must, as such, be limited in its duration. And moreover, that, with the generality of men, few things are more capricious than taste—however influential;—more common than envy;—or more confident than ignorance;

—it will serve to show the little of importance which opinion in affairs of science—however consecrated by long standing—should be allowed to exercise; when, divested of prejudice, it is dispassionately weighed and examined at the tribunal of right reason.

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INTRODUCTION.

At a moment when, from the progress making in chemical and electrical discovery, the darkness which through a number of succeeding ages, had so long and obstinately held enveloped and concealed the first principles of things, is at length, though slowly, giving way before the penetrating beams of science; and that the species of optical deception connected with the solar action, as refers to what is called *solar heat*,—similar to that by which it was so long preceded, in reference to the equally *apparent movement of the sun*, is about to undergo a similar fate;—as few, at the present day, are so simple, or wedded to ancient prejudices as to suppose that the heat induced by the sun is projected from his body, or has its source in combustion; but that it is, on the contrary, of *home growth*, as being *the result of a local action on the atmosphere, excited by the sun*;—at a moment such as this, I say, so interesting to every true friend of science, when, as if escaping from the last strong-holds of ignorance and barbarism, men's minds are occupied

on, and looking forward to the attainment of a more intimate knowledge of, and acquaintance with the hitherto mysterious operations of nature in the atmosphere; and that,—similar to lighting on a new vein of ore,—every new advance made in so ample a field, is likely to prove a new source of wealth, of security, or of admiration to mankind. Having, (as proved by some former publications,) from my idea of its importance, devoted some years of no ordinanary industry, and I may add of solicitude to this pursuit, and, probably, pushed my inquiries still further than others; and having collected, with some care, these the fruits of my persevering application, under the impression that they cannot fail to interest from their novelty, or to prove advantageous from their connexion with the general interests of society; and, whether erroneously or not, esteeming them the richest tribute that it were in my power to offer at the shrine of Science, or of utility; I am thus induced, with all possible deference, to present them at the tribunal of public opinion.

As in the physical world all things are connected, so in the intellectual every thing is consecutive; and this is so much the case in science, that it is not before the way has been prepared by an advance in certain of its departments, that any thing can be done towards the advancement of others; for, from the intimacy of their relations, they may be said mutually to touch, and either to borrow or to reflect light

on each other; so that, something like the *Horloge Botanique* of Linnæus, in the march of the sciences, each may be said to have its relative, and, as it were, stated period of development. This, however, can be only considered to apply generally, for, as coming within the list of those singular anomalies *, in which in science, equally as in physics, Nature occasionally indulges; in the list of the sciences there is *one*,—and this, it may be said, the most important of them all,—which owing at once to the bodies that, from their connection with, compose its members, and to the nature of the agencies, combined with the inadequateness of the senses or ordinary faculties of man to grapple with its parts, must be considered an exception to the rule, as though, in mockery, placed without the pale of human attainments; and is it necessary for me to add, that the science alluded to is *Meteorology?* embracing within its range, as it does, on the one hand, the globe we inhabit, and vivifying with its breath the whole of the animal and vegetable kingdoms of which it is the

* "C'est ainsi que la nature," observes Raynal, in treating of the diamond, "se joue dans tous les règnes par une infinité d'anomalies surprenantes. Tantôt elle semble s'astreindre, dans la chaîne et l'échelle des êtres, à l'ordre des nuances insensibles; et tantôt rompant toute série, elle fait un saut brusque, laisse derrière elle un vuide immense, et pose deux bornes éloignées dont il est impossible de remplir l'intervalle."—*Histoire Philosophique*, tome viii. page 154.

theatre; and, on the other, claiming kindred and connexion with the entire of that external nature, with all its skyey influences, composed by the sun and remainder of the planets.

From all which, I say, it will readily be seen, that owing to its nature, very considerable advances in the most abstruse of the sciences, (chemistry and electricity,) became, in the first place, necessary, in order, with any prospect of success, to make even the slightest progress in meteorology; and that, even provided with such aids as these sciences could furnish, it was still but a matter *of chance*, whether man should ever succeed in obtaining an adequate acquaintance with it. And thus that, as observed by Voltaire, if "l'estime des hommes se mesure par les difficultés surmontées," he who, by his industry, should succeed in exploring the sources, and in tracing the rudiments of this science, so as to establish it on principles such and so immutable as that succeeding years would only serve the more fully to confirm and prove their correctness,—would, at the least, have merited well of his contemporaries, and have established thereby a just claim to the respect and gratitude of posterity.

But if to attempt this, when so many, and these not of the ordinary class of men, had proved unsuccessful, were little short of madness: to succeed in such an attempt were, on the other hand, little short of miraculous. And yet such, and so unequal was

the task proposed to himself by the writer, when, many years ago, he first directed his attention to the subject of meteorology: by no means aware of the nearly insurmountable nature of the difficulties by which, at every step, all his attempts to advance were beset, and which only developed themselves in proportion to his application, and to the more intimate acquaintance which it gave him with the subject. As, however, continually recurring to the same subjects, and viewing them on all their faces, and in their various bearings, gradually begets a species of *acquaintance* which nothing else can give. Thus, though repeatedly discouraged by the want of success, and more than once determined altogether to abandon the pursuit as hopeless, (and which the losses induced by the two works he published on the subject were not much calculated to alter,) continuing to take lessons from failure,—as considering them the best account to which it could be turned,—under the impression that success was still possible, and aware that the thread of connexion between phenomena apparently having no relations is frequently so fine, as that it is the privilege only of long and intimate acquaintance with them, to see and detect it, and which, if once broken,—it might, however necessary, take ages to restore, induced him to persevere: till finally, aided by the acquisition of some new facts elicited by recent experiments, which enabled him to trace certain pheno-

mena to their principles, and thus to fill up some important blanks in the chart of natural causes, combined with some unlooked-for discoveries of another kind, he now feels enabled fearlessly to challenge inquiry, in reference to the correctness of the principles assumed by him in the present theory.

The better, however, to show the nature of the difficulties which had to be surmounted, it may not be amiss, in this place, to enter a little into particulars. Thus, in reference to the principle of temperature, assuming it to be local, and to result from the union of opposite actions in the atmosphere; as the only forces besides that of gravity, (of which we shall have occasion to speak presently,) with which we are acquainted in the atmosphere, are those of magnetism and electricity, the task of connecting heat with the latter was easy; as in the various experiments in electricity, the evolution of heat by electrical currents has always been found to be one of their characteristics, and consequently but little objection had to be apprehended from the assumption that planetary heat has its source in electric action. In assuming, however, that planetary *cold* has its source in *an active*, and not, as had been supposed, in a passive principle, or the absence of heat; and to obtain the necessary proofs that this was the case—however reasonable to suppose—was an affair of quite another kind. For, as gravity could not be supposed to have any thing to do with

the temperature, magnetism being then the only other force besides electricity, of whose existence in the atmosphere we are acquainted, and between which and cold there was no possibility, by direct experiment, to prove a connexion; and that, unless this connexion could be satisfactorily established, a most important blank would always remain to be filled up, which would have the effect of leaving the science of planetary temperature in a most defective state. Thus, as nothing in the way of elucidation was to be expected from experiment, it became necessary to obtain proofs of the assumed connexion, if such were to be had, from the phenomena of the atmosphere itself, as being, under the circumstances, the only alternative which remained. And the first of these which seemed to stamp the connexion sought for, was, that as the position of the magnetic pole, or rather poles, of our hemisphere, (as it is supposed there is one in Northern Asia,) are known; and that, according to the observations of Sir Charles Giesecke and others, it is found that the isothermal lines of Europe and Asia, separate in the higher latitudes, and surround two poles of maximum cold, one in America and the other in Northern Asia, and which, to a certain extent, are found to correspond, in their positions, with those of the magnetic poles in those regions, that thence, if not altogether positive, there was strong presumptive proof that cold was connected with, and an

effect of magnetic action. As this, however, amounted to no more than presumptive proof, it required something more positive, in order absolutely to establish the existence of the assumed connexion. And, accordingly, this desideratum has been at length obtained, and in a manner equally full and conclusive as if from actual experiment; and with it the discovery of another fact in meteorology, of probably equal importance, viz. the indispensable necessity which exists for the presence of *magnetic action*, in order to the formation of *rain* in the atmosphere; and thus that, instead of being, as had been supposed, an effect of the chemical process of condensation, the formation of rain is the effect of a particular species of meteoric action in the atmosphere, the same as the phenomenon of cold, viz. that as the principle of its temperature is the effect of one species of meteoric action in the atmosphere, rain and its accessories are effects of an opposite species of this action in its body. Thus, in having my attention called to the peculiarity of the climate of Lima, where, as is known, though fog is common, *it never rains*, or if at all, not more than once, perhaps, in two or three years; this circumstance appeared to me so singular, that, aware it must have its source in something *local*—taking into account the extraordinary elevation of the Andes in its vicinity, as of their position in reference to the site of the *magnetic pole* of the southern hemisphere;

situated (as shown by the direction of the compass needle,) to *the east* of these mountains, and consequently on the opposite side to that of Lima and its territory—which, taking into account the great elevation of these mountains, must have the effect of *intercepting its action* on the region of the atmosphere in which rain-clouds form;—considering this circumstance, I say, it immediately occurred to me, that to this interruption of the magnetic action of the proximate pole on the atmosphere in this part of Peru, as to its true cause, was to be ascribed the phenomenon noticed in its climate. And in testing the principle with the countries of the northern hemisphere, by the difference of climate observable on the opposite sides of mountains whose course crosses the line traversed by the magnetic meridian, I found it in every instance, though not to the same extent as at Lima, (owing to the obstruction, with that of the elevation of the mountains not being so great,) fully borne out; the greatest humidity being, in all cases, on the side which fronts the magnetic pole; and the greatest drought of climate being on the opposite side. And, as being a necessary consequence, that, in order to the progression of the meteor in the atmosphere in which rain has its source, magnetic action is so necessary, that where it is interrupted to a certain extent, as at Lima, it cannot take place. This discovery, however, though indispensable, was no more than a centre link in the

chain of evidence which was necessary, in order to identify magnetic action with the phenomenon of planetary cold, but of which (in comparing the seasons since the severe winter of 1829,) the constant proportion which I find to exist between the ***relative cold*** or severity of the winter in the southern hemisphere, and that of the ***relative humidity*** of our summers, and ***vice versâ,*** may be considered as ***conclusive;*** insomuch, that no further doubt can exist, but that planetary cold is the effect of an active agency, and that that agency is magnetic action.

Thus, much had been done towards throwing light on some of the most obscure recesses of meteorology; but still a most important question remained to be disposed of, viz. that of ***gravity.*** For if, as assumed, that magnetism and electricity are the only ***active forces*** in nature,—according to this showing, gravitation, similar to the remainder of her phenomena, should be the effect of the action of these forces in the local atmospheres of the sun and planets: but how obtain the proof? The proof has, happily, been obtained by the experiment of the ***helix,*** as will be found more fully treated of in the following pages, and which thence goes to show, that as the force of gravity, whether in the sun or planets, results from the local action of the electric and magnetic forces in their atmospheres, that its range, as connected with these bodies, must necessarily ***be local,*** and consequently can have nothing

whatever to do with *their movements*, as in the absence of more correct data was supposed to be the case.

Again, experiment has instructed us of the law by which electrical and magnetic currents are governed, when, as in the atmosphere, they are brought to act together, viz. that *they cross* or *traverse each other at right angles*. A discovery so important, it may be observed, that had it not been made, it were vain to hope (as it could not be conjectured,) that we should, *at any time*, succeed in obtaining a knowledge of the true system of the world, as on this discovery mainly depended that connected with the principles and laws which give movement to the sun and planets: for, assuming, as stated, that the only active forces in nature are those of magnetism and electricity, it is known that "if we communicate electricity to an insulated metallic sphere, we shall find the whole electrical power *diffused over its surface*," and consequently, that in making this application to the spheroid of the earth, sun, or other of the planets, the superficies of these bodies constitute the chief theatres of the action of the electrical, equally as of the magnetic forces connected with them; and further, that by the union of these forces their respective powers are most materially increased, as proved by the experiments made on the magnet.

By uniting these circumstances with the law of electrical and magnetic currents, of crossing each

other at right angles, and in making their application to the principle of planetary movement, similar to that of metallic plates, which they are known to effect—as the plain or axis of magnetic action in the earth, and by analogy in the sun and remainder of the planets, corresponds to the plain of the ecliptic, or the path traversed by the planets, in their elliptical movement round the sun, as the axis of electric action locally in these bodies, with that described by their movement of rotation; it will follow that, simply by the operation of these forces in the local atmospheres of the planets, acted on by the sun, the principle of movement, both elliptical and rotary, must, as of necessity, be imparted to them thereby, in the manner we behold, as will be found more fully treated of in the following pages. But as it is by means of the union and dependence which subsists between the sun and planets, that the local energy in the action of the electrical and magnetic forces in the atmospheres of the latter exists, and is upheld; and that such union must depend on a principle distinct from these forces, but on which their activity is based. Thence, as being that only, (considering the immense distances by which they are separated one from the other, as from the sun,) which could serve as a bond of union in common between the planets and sun, and at the same time serve as the base of the local energy of the magnetic and electrical forces in their atmospheres,—the as-

sumption of our theory, viz. that *reflective action* is the principle on which the unity of the solar system, as the activity of the forces of nature therein is based, as being that only which corresponds to the conditions requisite in such an ultimate principle, or primary *first cause.*

But if, as assumed, this were the grand *moteur* of Nature in the physical world, there should be something more than conjecture in the way of proof, in order to show that such was the case; and, accordingly, the requisite proofs are not only supplied by the changes observable in the phenomena of the tides, which always quadrate with the greater or less amount of reflective action subsisting between the the sun, earth, and moon, as depending on the greater approximation to, or elongation of, the latter bodies, whether individually or combined, in their respective circles, from a direct opposition to the solar action, but likewise by the *diurnal variations of the compass-needle,* and *barometrical variations corresponding to the phases of the moon,* as connected with the lunar circle of meteoric action; in such way, that it may be said there is no proposition in geometry more fully demonstrated than the principle of reflective action, considered as the *primum mobile,* or first cause in physics.

Thus, it will be perceived, there exists neither blank or chasm in the evidence by which the principles assumed by the present theory are, in all their

parts, sustained and borne out; insomuch that, without incurring the charge of vanity—in allusion to the words applied by Augustus to Rome, that he found its buildings of mud, and left them of marble—the author, with some pride, may say, that he found the edifices of meteorology and astronomy composed of defective, and consequently of perishable materials, but leaves them composed of such, that the corrosive action of time, instead of impairing, will only serve the more fully to increase their lustre, and eternize their stability. And as the various circumstances here alluded to will be found more amply treated of in the work itself, and thence that it may be asked, why introduce them in this place? his answer is, that by thus collecting in a view the chief heads embraced by the present theory, it enabled the author the better to show the extent to which the facts obtained from *experiments* enabled him to push his inquiries, as the large blank which had still to be filled up from other sources, where such facts could no longer assist; that thus, in defining the limits of each, a more correct idea might be formed of the difficulties that had to be surmounted. He had, indeed, some hopes, from his respect for long-cherished opinions, however erroneous, that, as connected with the principle of planetary movement, and as belonging rather to the class of *speculative truths*, the principle of Newtonian gravitation might be allowed to retire with all the honours of

war, till, similar to those by which it was preceded; it would, of itself, with the increasing conviction of its futility, die a natural death; but the "*damning proofs*" supplied by the *equinoctial phenomena* in the annual, as of their counterparts, so frequently repeated in the lunar circle, at the periods of the *syzigies*, induced by the *revulsion of magnetic action* in the body of the atmosphere, incident to the changes which, at these periods, take place in the sites of the *acting magnetic poles* of the earth and moon, from one to the other, with the change of their positions in the ecliptic, alternately, connected as these phenomena (as we have so clearly shown) are with magnetic action—are such and so incontestible, that this, the elliptical movement of the earth, moon, and, by analogy, of the remainder of the planets, has it source in, and is an effect of, magnetic action, as assumed by our theory, (and the manner of which will be found more particularly described in the work,) that, except at the expense or abandonment of truth, there was no possibility of passing it over, or of allowing it to remain.

In reference to the division and local distribution of the electric and magnetic forces in the sun and remainder of the planets as in the earth, assumed by our theory—as it were only by sameness of disposition throughout these bodies, that it was possible for nature to act as she does, *by general laws*. Being aware that this is the disposition of these forces in the planet we in-

habit, enables us to speak with the same certainty of the existence of this division and distribution of them in the sun, &c., as though we had been transported to each of these bodies respectively to ascertain the fact. And, thus fortified, he has not hesitated to assume that such is the case, and to deduce his inferences accordingly, when necessary. "Les travaux des hommes," observes Raynal, in treating of the monuments of ancient Mexico, "ont toujours été proportionnés à leurs forces et aux instrumens dont ils se servoient. Sans la science de la méchanique et l'invention de ses machines, point de grands monumens. Sans quarts de cercle et sans télescope, point de progrès merveilleux en astronomie, nulle précision dans les observations. Sans fer, point de marteaux, point de tenailles, point d'enclumes, point de forges, point de scies, point de haches, point de coignées, aucun ouvrage en métaux qui mérite d'être regardé, nulle maçonnerie, nulle charpente, nulle menuiserie, nulle architecture, nulle gravure, nulle sculpture."—*Histoire Philosophique*, tome cinquième, pag. 258. And, by parity of reasoning, before discovery had succeeded to ascertain the principles and laws of nature in the physical world, how were it possible that any of the sciences connected with the operations of nature, not alone in the atmosphere, but in the animal and vegetable kingdoms, could have ever attained to more than a relative degree of perfection? and of which the de-

partment of meteorology, more particularly connected with the seasons and changes of the weather, may be cited in the way of illustration; for no one is ignorant of the efforts that have been successively made by some of the greatest men, both of the present and former times, to penetrate the veil which envelopes her operation in the atmosphere; and as individual exertion was found unequal to the task, that—as occurred in the Palatinate—aware of its importance, associations were even instituted with the view the better to forward this object. And yet what has been the result, notwithstanding all the instruments that have been invented, and all the information collected from journals of the weather, continued for years in different countries, &c. &c.? Why, that it has continued in the same state, or nearly so, in which it was at the time of Virgil, and all *from the ignorance of principles;* as it still continued to have no better ground than *empiricism* for its base. These facts, it is presumed, will serve to illustrate the nature and importance of the discoveries connected with the present theory, assuming them to be well founded, opening, as they are so well calculated to do, so many new sources of wealth and of security, and supplying by their aid much, if not all, that was wanting towards the perfecting of other departments of science.

And if the observation, that "Dans le monde politique, comme dans le monde physique, un grand

évènement a des effets très-étendus," be, with reason, much more applicable to the world of science. And, as observed by Rosseau, that, " La science est une monnoie qui n'ajoute au bien-être qu'autant qu'on la communique, et n'est bonne que dans le commerce." As the discoveries noticed, in their present state, may be likened to so many wild plants of the wilderness, which, when first found, require the hand of culture, in order to domesticate and extend the range of their usefulness; and that as far as I know of, though we have societies for the promotion of science in almost all its other departments, we have none for the advancement of meteorology,—the root, in common, of the entire of the natural sciences, inasmuch as it may be said to embrace within its range the first principles of them all,—and which thence claims precedence even of astronomy itself, hitherto considered the first in the list. To remove this anomaly,—only to be accounted for from the circumstance that, in the absence of *principles,* (now happily obtained,) persons desirous to promote it, being without any *rule of guidance*, and perceiving the futility of *observations* without such rule,—not knowing exactly what to be at, had given up all attempts of the kind as hopeless;—as being, I say, at the same time, the only sure and effectual way to facilitate, with that of the knowledge of them, an extension of their usefulness commensurate to its amount; it is evident the friends and patrons of

science in England should lose no time, (as the country may claim the honour of these discoveries,) in setting the example of forming a *Meteorological Society,* the first of the kind, in order to promote the knowledge of this science, as of the various important objects to which it is applicable, and which, if thus set on foot in this country, could not fail of being quickly imitated by others; which, by means of the enlarged correspondence thus organized, would soon, by the perfecting of such parts of the present theory as still stand in need of time and increased observation, in order thereto, be productive of the most extensive and important results. And it is easy to see that one of the first results that would attend the formation of this society would be that of the construction of *weather almanacs,* adapted to the different latitudes of both hemispheres, which, very different from those at present *so called,* would, after some time, point out the periods of the changes in the weather, as those throughout the year when *danger from storm by sea* had to be apprehended, with the same fidelity as the changes of the tides, and which, as the first in the list of maritime powers, England evidently has the deepest interest to promote; for if, as assumed, that the principles in which these changes in the weather and violent class of atmospheric phenomena have their source, may henceforward be considered equally well-known and established as those of any proposition of Euclid;

why should not the same precision as to results be expected to follow from calculations founded on them in the one case as in the other? And as the field embraced by meteorology is so vast that no more than an *ébauche*, or rough outline thereof, could be attempted in the present work; and, consequently, that it will require both time and industry to fill up accurately, and perfect its details. And further, lest it should pass *on record* that discoveries such as these, which, as truth is immortal, are likely to attract so general and lengthened an attention to them, have not been met in the spirit, or responded to in the manner, which—at a time like the present, when, from the increasing conviction of its importance, science is more assiduously cultivated in this great country than at any former period of its history—might be expected. Let us hope, both for the honour of science, of humanity, and of the country to which it is addressed, that this appeal will not have been made in vain.

Neither is it a reason why, because he who has been so fortunate to make these discoveries has not the honour to belong to this or that scientific body, that this his appeal to the friends and patrons of science in these countries, should not excite the same lively interest, and be equally responded to, as though it were in his power to produce certificates of connexion with them all. For, as it appears to be an established rule with scientific bodies, neither

to countenance or assist with their name, or otherwise, the exploring of any *speculative point,* before the certainty of its being succesful is no longer matter of doubt; and that, in addition, the habit of viewing subjects in a certain light, and of considering certain phenomena as being the effects of certain defined causes, through a number of years, contracted in early life, as usually happens to the members of these associations; by reason of the *bias* it imparts, though in most cases altogether unconsciously, disqualifies them, in great part, from originating any thing either new or extraordinary; and which, with some reason, caused Voltaire to observe that "Les grands hommes se sont *tous* formés ou avant les Academies, ou *independamment d'elles.* Homère et Phidias, Sophocles et Apelle, Virgile et Vitruve, le Tasse et Michel-Ange, n'etaient d'aucunes Académies; le Tasse n'eut que des critiques *injustes de la Crusca,* et Newton ne dut point à la societé Royale de Londres ses découvertes sur l'optique, sur la gravitation, sur le calcul intégral, et sur la chronologie. A quoi peuvent donc servir les académies? A entretenir le feu," he continues, "que les grands génies ont allumé."

Besides, it may be further observed, that, talents apart—it requires both the enterprise and the perseverance of a Cortès, in order to effect anything great, whether in science, in war, or indeed, in anything else; and which none but members of what

may be denominated *Nature's Aristocracy* are likely either to attempt, or to succeed in. And this it was, probably, which with his accustomed accuracy and deep knowledge of the human character, caused the great Frederick, in his Memoirs of the House of Brandenburgh, speaking of the intimacy to which that singularly gifted princess Queen Sophia Charlotte of Prussia admitted the celebrated Leibnitz, to observe, that—"as those whom Heaven has favoured with a particular dignity of mind, are capable of raising themselves upon a level with sovereigns, she entered into an intimate acquaintance with Leibnitz," &c. page 236. From all which, the writer hopes to make it appear, that, though not sparkling with academic honours, or coming recommended with the certificates of the different scientific bodies of Europe,—this his appeal to the good sense of the friends and patrons of science in these countries, to set on foot the formation of a meteorological society in London, at the present interesting moment, should not be the less favourably received or promptly responded to;—that is to say, in a manner corresponding to its importance and to the necessity which exists for an institution of the kind. The latter, it may be observed, and not the individual who has the honour to make the appeal, being the object to keep in view; and which, it may be added, when, as in this instance, it can be clearly shown that the advancement of such object is ne-

cessary to, or required by the interests of society, (whoever the party may be who introduces it,) is almost sure to meet with attention from the public-spirited and enlightened people of this country,—"the first in *daring*, as the first in fame."

Strange indeed, anomalous, and unequal, is the partition which but too frequently occurs in affairs of this kind; for though a world may eventually partake of the advantages derived from the labours of an individual who devotes himself to forwarding any particular department of science, or of the arts, he has usually in the first place, as occurred to Harvey and Fulton, not only to set up with the labour, the risk, and the expenses incident to the attempt,—and which, if not successful in, no friendly hand is extended to, to alleviate or lighten the effects of,—but which, even though he succeed, while the public reap the advantages, little more remains to him than the empty "whistlings of a name," with perhaps the legacy of impaired health and fortune. To remedy this, no doubt, and assuredly from the wisest as the most just of motives, it is, that it has been the practice of all enlightened sovereigns and governments, to extend their protection to such men. And, as has been justly observed by the illustrious author of the "Memoirs of the House of Brandenburg," already cited, that as "Princes have never been able to *force nature* to produce those great men whose names alone are capable of rendering ages memora-

ble to posterity;" it becomes, in some sort, a sacred duty in them to extend their protection to such men, when she does. For if, in the lengthened vista of retiring years, that other objects, to use an expression of Lord Byron, curdle, contract, and finally disappear; while, as observed by Reynal, the memory of a Columbus, a Newton, and a Descartes, continues to live green in the memory of posterity; it were, to say the least of it, bad taste for those in whose hands are deposited the fountains of honour and of wealth, not to mark by their conduct the sense they entertain of those common benefactors of mankind.

This, it may be observed, was the feeling which animated that extraordinary man Louis the Fourteenth, who, whatever his other defects might have been, was as lofty a specimen of moral grandeur as any that modern times has produced. And this was not only the spirit of his government, but of *France* during his reign, being simply what that of any great country should be at all times. For, as observed by St Pierre, of the French of those times, "Il n'y a peut être pas *une grande maison* qui ne puisse se glorifier d'avoir poussé en avant et mis en évidence, quelque homme des familles du peuple, ou de la simple nobless, qui est devenu célébre dans les arts, dans les lettres, dans l'église, ou dans les armes, par leur moyen:"—and yet where is the Frenchman who does not exult in the recollection of *Louis le grand* and of this the Augustan age of France?

And it is not without pride on the part of the writer, that he feels himself enabled, without adulation, to compliment our most gracious sovereign, equally as the members of his Government, on the protection which they manifest so much willingness to extend, to persons of literary acquirements and scientific pursuits:—a protection which, it were unjust not to notice, *was not* omitted or lost sight of by their predecessors during the short administration of Sir Robert Peel. This is as it should be; for, as knowledge, happily, is of no sect or party, but like to its emblem, the sun, extends its benign influence alike to all casts and denominations of men; it were unfortunate if party-feeling were allowed to prevent an equal distribution of the royal bounty to *merit,* to whatever creedor colour it might belong. And they may rest assured—personal considerations apart—that if the royal bounty be never worse bestowed than on works of this kind, there are few in Old England so little alive to its literary fame, but will feel grateful for such an extention of it. For, as being illustrative of the existence and extent of this feeling in England,—amongst the members of what other commonwealth or community be it asked, shall we be able to find an individual who, like the late Lord Bridgewater, has bequeathed the munificent sum of £8000, for the publication of a work on one of the most noble ends of science, and which could only be accomplished through its aid, viz.,

"On the Power, Wisdom, and Goodness of God, as manifsted in the Creation?"

In regard to style, I may say with Raynal, that " J'ai fait tout ce qui étoit en moi pour m'élever à la hauteur de mon sujet. Mais combien les gens d'un goût délicat me trouveront encore éloigné du ton réservé aux écrivains de génie!" And as to the quotations from the latter and other French writers, so frequently introduced into the pages of this work, they, as I conceive, hardly demand an apology; for how were it possible to touch on this, or indeed any other subject connected with science or literature, without drawing largely on so rich a mine? Besides, from the knowledge of the French in this country being so general, I thought it would be little other than incurring unnecessary trouble and expense, to add literal translations of those quotations.

I may in conclusion observe, that instead of the matter which I esteem to belong to meteorology being exhausted in the following pages; I have omitted touching on some points which, in a scientific point of view, might be considered of importance, in order as much as possible to economize space.

METEOROLOGY

Considered in its Connexion with Astronomy, &c.

FIRST PART.

" Malgré tous les efforts du génie, il faut plusieurs siècles à une science, avant qu'elle puisse être réduite à des principes simples. Il en est des théories comme des machines qui commencent toujours par être très compliquées, et qu' on ne dégage qu' avec le tems, par l'observation et l'éxpérience, des roues parasites qui en multiplioient le frottement."—RAYNAL.

CHAP. I.

Planetary Cold an Effect of Magnetic Action.

IF in the most simple calling or profession it is only by progressive and slow degrees that even an approach to perfection can be obtained, it will excite no surprise if, in the least known and most difficult of the sciences, meteorology, the progress of discovery in the various departments of experimental philosophy, so characteristic of the present age, should induce in their train corresponding changes in the ideas, as connected with planetary

temperature, &c. hitherto assumed by me in my published works. And thus, as introductory to the present treatise, I am induced to offer some observations on this subject, suggested chiefly by certain of the recent discoveries which have been made in magnetism and electricity, viz. those which have made known the species of connexion which subsists between these forces, when (as in the atmosphere,) they are combined. And, in reference to this connexion, the circumstance as relates to the principle of temperature, to which I would more particularly direct attention, is the law between electric and magnetic currents *of crossing each other at right angles;* which, applied to the earth and its atmosphere,—as the axis of magnetic action indicated by the magnetic meridian, traverses the opposite hemisheres of the earth throughout their extent, from pole to pole; and, (as shown by the dipping-needle,) has its centre at the line; that the axis of electric action in the atmosphere concentrated at the latter, crosses that of magnetism at right angles, or from east to west. Thus, in referring the activity of these forces in the atmosphere to the solar action, and in connecting this their local action with the principle of its temperature, as heat is assumed to be an effect of electric, so planetary cold is assumed to be the effect of magnetic action. For, as the highest temperature occurs on or in the vicinity of the line traversed by the axis of electric action between the tropics, and

thus corresponds in position with that of its main focus,—it would follow, by analogy, even in the absence of more conclusive proof, as the greatest cold of winter occurs at or in the vicinity of the pole of the winter hemisphere, that if heat be an effect of electric, so cold is an effect of magnetic action. And that thence cold, equally as heat, is the effect of an *active,* and not, as had been supposed, of *a passive agency,* "Le froid, disons-nous," observes St. Pierre, "est produit *par l'absence de la chaleur,* mais si le froid n'est qu' une qualité *negative,* pourquoi a-t-il des effet positif? Si vous mettez dans l'eau une bouteille de vin glacé, comme je l'ai vu faire plus d'une fois en Russie, vous voyez en peu de temps la glace couvrir d'un pouce d'épaisseur les parois externe de la bouteille."* And did any doubt exist as to this being really the case, the separation which occurs in the *isothermal lines* during winter, in the higher latitudes of Europe and America, where, as has been ascertained, they converge to and surround *two poles of maximum cold,* the one in North America, the other in northern Asia: and that in, or closely proximate to the same latitudes and localities, a similar separation and convergence of magnetic action to opposite poles, situated as the former on either side and about equidistant from the pole of the earth's rotation, takes place.

* Voyez Etude de la Nature. T. 11. page 48.

Taking, I say, into account the extent to which magnetism equally as electricity, is blended and identified with the atmosphere and its phenomena, these facts should be considered to afford a proof little short of demonstration, in reference to the assumed connexion of magnetism with cold, equally as with the *aurora borealis*, *&c.* in reference to which the proofs of such a connexion, from the influence exercised by these phenomena on the compass-needle, are less equivocal. And as the facts connected with this assumed identity of magnetism with planetary cold, are contained in the following extracts from Mrs. Somerville's excellent work "*On the Connexion of the Sciences*," I am thence induced to give them insertion, viz.—"It appears that the isothermal lines, which are nearly parallel to the equator for about 22 degrees, afterwards deviate more and more. From the observations of Sir Charles Giesecke in Greenland, of Mr. Scoresby in the Arctic Seas, and also from those of Sir Edward Parry and Sir Fohn Franklin, it is found that the isothermal lines of Europe and America entirely separate in the higher latitudes, and surround two poles of maximum cold, one in America and the other in the north of Asia, neither of which coincides with the pole of the earth's rotation. These poles are both situate in about the 80th parallel of north latitude. The transatlantic pole is in the 100th degree of west longitude; and the Asiatic pole is in the 95th

degree of east longitude." Page 283, and subsequent. And further—" It appears from late researches, that the law of terrestrial magnetism is of considerable complexity, and the existence of more than one magnetic pole in either hemisphere has been rendered highly probable. That there is one in Siberia seems to be decided by the recent observations of M. Hansteen: it is in longitude 102 degrees east of Greenwich, and a little to the north of the 60th degree of latitude: so that by these data, the two magnetic poles in the northern hemisphere are about 180 degrees distant from each other.—Captain Ross places the American magnetic pole in 70° 14′ north latitude, and 96° 40′ west longitude." Page 331.

Further, it has been observed that the highest temperature or greatest heats of summer, in our northern hemisphere, do not occur, as might be supposed, *at the line,* but at the distance of from fifteen to twenty degrees to the north of it. And, in like manner, we observe that the poles of maximum cold do not occur immediately at or within the same parallels as the poles of magnetic action, but at about the same distance *to the north of them,* as that of the greatest heats in summer *north of the line:* the analogy between the position of the main foci of either action, whether at the line or in the arctic regions, and that where they induce their greatest effects on the tempera-

ture in summer and winter, as noticed, being in this respect perfect. And I mention the circumstance as illustrative of the correctness of the principle of *reflective action* in its connection with planetary temperature; as, according to this principle neither the greatest heat in summer, or cold in winter, could occur immediately at the sites of the main foci of the actions which induced them; but in positions where, and at such a distance to the *north* of them as the concentric action of either force on the entire surface of the hemisphere at either season might be expected to collect, and produce its greatest effect; and which, in both these cases, as we perceive, is fully borne out by the fact.

CHAP. II.

The Moon exercises a meteoric Influence on the Temperature and Weather, which changes in its Nature with that of the Moon's Position, being electric at the Syzygies and magnetic at the Quadratures.

But the lunar action on the weather, as assumed by our theory, partakes alternately of both actions, viz. that it is *electric* during three days before and after the *syzygies*, and *magnetic* during similar periods preceding and following the lunar *quadratures*,

And thus, were our principles correct, the same analogy should be found to exist between the appearance of the *aurora borealis* and the lunar action at the periods of the quadratures, as between the magnetic poles in the arctic regions, and the sites of those of maximum cold; and which as being in some sort *counterparts* one of the other, should, if such were the case, be taken as additional evidence not only of the correctness of the principles assumed, as connected with the temperature, but as connected with the assumed nature of the lunar action on the weather. And by taking into account, that, at about the period of the winter solstice,—(on the assumption that the cold of winter is an effect of magnetic action)—such is the relative amount and force of magnetic action at this period, *in the annual circle*, that it may be said to merge for some time the opposite actions of the moon—both electric and magnetic—and consequently that the meteoric changes connected with the annual circle, not only at this, but at other periods of the year, by outweighing the influence of the lunar action, may occasionally determine still more than the latter, the periods of the occurrence of the aurora-borealis, as of storm, &c. Taking, I say, this circumstance into account and referring *to facts*, it may probably excite our surprise to perceive the extent to which the coincidence between the periods of the appearance of the aurora-borealis during some years past, and those of

the lunar quadratures, will be found borne out thereby. In reference to the aurora-borealis it may be further observed, that its appearance whether preceding the equinoxes, or the periods of the most violent storms in winter, is almost always connected with the great meteoric changes in the annual circle; which makes the preceding observations the more necessary. And as at the periods I took notes in reference to the appearance of the aurora, my object in doing so had no reference whatever to the present subject, but simply as regarded the share which the lunar action might be supposed to have had in their production; the instances I cite will be the less suspected of bias or partiality as being got up for the occasion. Thus, "On the 7th inst., in the evening, a magnificent aurora borealis was seen at Brussels. It lasted from six to a quarter past nine o'clock."—*Galignani* of the 14th December, 1830—Being, (as will be seen by referring to the almanac,) exactly at the period of the *second quadrature* of the moon. Again, "A splendid aurora borealis was seen at Limeric, about ten o'clock on Saturday night, the 11th of December, which continued for two hours."—*Limerick Chronicle*, 15th December, 1830.—This latter, it will be seen, occurred on the fourth night after the preceding, or at the conclusion of the same lunar tide, when its magnetic action was most powerful. Again—"On Saturday evening, (25th of December,) with a clear

sky, a beautiful aurora of a deep red colour was observed at Edinburgh."—*Galignani*, of the 4th January, 1831. This aurora was likewise seen from Portsmouth, as reported in the *Courier*, of the 27th December, 1830. The period of its occurrence, similar to the preceding, having been at the conclusion of the lunar tide of the first quadrature, which occurred on the 22d of December. Again, on the night of the 7th of March, 1831, being that subsequent to the period of the second quadrature of the moon, which occurred on the 6th, an aurora was seen at Dublin, of which I was a spectator. This was the precursor of the equinox, which set in with great violence on Sunday the 13th of March, the eve of new moon. A second instance of the aurora occurred at Dublin on the morning of Wednesday the 18th of September 1833, as reported in the *Pilot*, Dublin Paper, of the 20th of that month: being two days before the period of the first quadrature of the moon, on the 20th or period of the setting in of this lunar tide: having been, as the former, the precursor of the equinox. Again, " A splendid aurora was seen at Worcester, on Monday evening the 22d December, 1834, as reported in the London *Globe* of the 27th December, 1834; being only a few hours preceding the period of the second quadrature of the moon, which occurred on the 23d of the month. An account of this aurora, from the pen of Mr. Sturgeon, as seen from Woolwich, ap-

peared in the *London Philosophical Magazine,* for March, 1835. And finally, may be noticed the aurora seen from Scotland on the night of the 17th of November, 1835, as reported in the papers, and which was the immediate precursor of the tremendous storm which occurred there on the following day, as will be found noticed in a subsequent article. This having been the lunar octant which succeeded the period of the second quadrature on the 13th or conclusion of this lunar tide.

It is not pretended that the whole of the auroras which have appeared in our skies since 1830 are here reported, as no particular attention was paid by me to the subject; but it will appear remarkable that, in the entire of the instances cited, not one occured at or about the periods of the lunar syzygies, while the whole of them are found connected with the opposite periods of the moon; and, consequently, that the fact must be considered as not slightly corroborative of the truth of the assumption in reference to the nature of the lunar action on the atmosphere at the period of the quadratures, being analogous to that of the magnetic poles of the earth, as noticed. And as the aurora is to be considered the precursor of storm and *rain*—as the latter, in our skies, is always found combined with the former—and, consequently, that the appearance of the aurora is connected with the incipient stage of the meteor in the superior region of the air, which subsequently de-

velopes itself in rain. This necessarily leads to an important question in meteorology, viz. *as to the principle in which this, the formation of rain in the atmosphere, has its source.* However, the better to understand my reasons for viewing this subject differently from others, it becomes necessary, in the first place, to recur a little to first principles; as, in the event of being fortunate in regard to these, the circumstances connected with this, equally as with the temperature, and the movement, both elliptical and rotary, of the earth, and, by analogy, of the remainder of the planets, will, as from their proper sources, be found naturally to extend and develope themselves; for, as observed by Raynal, "en tout, il faut commencer par le commencement."

CHAP. III.

The Union of opposite Progressions *esteemed the fundamental Law of Nature, or that on which the whole of her Dispositions are founded.*

It is a trite observation, but not the less true, that perhaps, of all others, *simple ideas,* however apparent, are the most difficult to seize on or to make the application of. Of this we have a sufficiently memorable instance in the well-known circumstance which led to the theory of *universal gravitation,* as, how-

ever frequent the occurrence and apparently unimportant the spectacle of an apple falling from its parent branch might be thought, it required, as appears, no less than the genius of a Newton to seize on and make its application to science in the manner he has done; and of which theory it will be sufficient to observe in this place, that, however erroneous in principle, as it was the first grand *approximation* which, in the lapse of ages, had been made to the true theory of the world, it merited that imperishable fame which it has so deservedly conferred on its great author. And, as further illustrative of the circumstance alluded to, what, for instance, do we hear more frequently repeated than the truism, that *every thing has it opposite?* And yet, however common the observation or undeniable the fact, how long has it not been allowed to float, as it were, and pass under the review of mankind, without any one having lit on that application of it to science of which, as I hope to show, it was so susceptible, from its having contained in it the germ of that universal law of nature in her dispositions which is, probably, the only one that admits of no exception, viz, *the union of opposite progressions of the same kind.* For, in order to show that this, the union of opposite progressions of the same kind, is *the fundamental basis* on which the entire of the dispositions of Nature, whether in the moral or physical world, are founded, and which, as observed,

admits of no exception, it will be only neeessary to test it a little in detail in order to be satisfied that such is the case. And, as being the lowest in degree, or first link in the mighty chain of being,—to commence with the *individual* in the animal and vegetable kingdom,—what, it may be asked, are the opposite, or *right* and *left* sides of animals? (whose contrasts and sympathies, as is known, have so frequently occupied the attention and speculations of the faculty;) the *root* and *stem* of vegetables? or the further sexual combination subsisting between the individuals of either kingdom? or if, rising still higher in the scale of existences, the union of the sun and planets? differing to such an extent as the former does from the latter; but, in every instance, this, the union of opposite homogeneous progressions?—The same fundamental law, as we shall find, being equally apparent in the world of sentiment and sensation; and of which combinations each of the senses and passions may be said to constitute *a centre,* or point of contact, to or from which the opposite progressions of heat and cold, of light and darkness, of pleasure and pain, of joy and grief, of love and hate, of desire and aversion, &c. &c. are to be considered but the opposite progressions. And of which universal law,—if I may be allowed to touch on a subject more properly belonging to metaphysics—the so often debated principles of *good* and *evil,* in the abstract, (and as being of the same

family,) cannot be considered an exception. This disposition, in short, being the source in common of the union, harmony, and endless variety observable in nature; in which, as has been observed, "*tout est double*, tout a son *pareil* dans les ciel, sur la terre, parmi les êtres; *la raison seule n'a pas de pair.*" And thus, as in the grand assemblage of nature, in reference to this disposition, *reason,* properly speaking, is the sole exception; and of which, notwithstanding, it (nature) is to be considered but as the incorporation, or *diverging rays;* and consequently that, as far as regards the ideas we are able to form of perfect unity and indivisibility, reason and *Deity* may be said to constitute exclusively the only perfect types. Do we not, I ask, in this circumstance, discover *the broad line* and limit which as it were *separates the Creator from his works?* And which view, it may be added, if rightly considered, is of itself sufficient to overthrow the entire of the abstruse mystifications of *Spinosa, Malbranche,* and all those who with them have affected to identify the Deity with his works. And, as in the material world we are warranted in supposing, from "the bearings and the ties,—the strong connexions, nice dependencies," which are observed every where to pervade it, that nothing therein occurred by chance or was done without object. And consequently that, according to this view, both *the forms* and *qualities* of bodies are to be considered but as

the *incorporation of the designs* which, in reference to them, pre-existed in the mind of the *Creator*, and by which, necessarily, their creation was preceded. Thus, I apprehend, it is, that forms and qualities should be regarded as *the types of ideas*; and that, by means of them, we are enabled to trace the conformity and connexion which, from the beginning, existed between the *invisible* and the *visible world*, or between the designs of the *Creator* and these his works.

And as, regarded in this light, the works of creation, both *animate* and *inanimate*, stand apart, and as it were detached from their source; and that the principle of *vitality* in the former, as *the forces* which uphold the equally vital principle of movement, temperature, and the other local phenomena of the heavenly bodies, on the one hand; and that of *instinct*, or *intelligence*, which though in proportions so various, may be said universally to pervade the individual members of the animal kingdom, on the other; can be only considered as the *direct emanations of the* DEITY; and which, consequently, though separate and distinct, thus exhibits the whole of nature, both physical and intellectual, touching by its opposite extremes, and as it were reposing on the latter. This view, I say, is calculated to show not only the intimate connexion, but *total dependance* which exists, has always existed, and must continue to exist, between the works of

creation and their *Source;* who thus permanently holds in his hands, and wields, the first springs of the three grand principles of *movement, vitality,* and *intelligence,* by which they subsist.

But lest, similar to others, I should lose myself in pursuing a subject such as this, it is time to resume that which led to the digression; and, (considered in regard to science,) in applying the law of *the union of opposite progressions* to the principle assumed by our theory, in reference to that of *reflective action,* on which it is based, considered as the *first cause* in physics, equally as to the principles assumed in reference to the movement, temperature, &c. of the heavenly bodies; we shall find, as I hope to show, the entire of these principles in accordance with this law; for, in reference to the first—*reflective action*—in the sense here understood, necessarily depends on the union of opposite progressions of the same kind, as subsisting between the sun and planets respectively, equally as between the primary and secondary members of the latter bodies, being, in its essence and nature, altogether the opposite to the law of *universal gravitation,* which is but another name for universal *aggregation.*

CHAP. IV.

Opinions entertained by some Writers in regard to the Newtonian Principle of UNIVERSAL GRAVITATION.

In reference to this principle, considered as the basis of the Newtonian theory, the following observations may not appear uncalled for, showing as they do, even in the absence of anything better to substitute in its place, the ideas entertained by some of the most enlightened men on the subject. "Si la nature, par exemple,"—observes *St. Pierre*, "étoit régie par les seules lois de *l'attraction*, comme le supposent ceux qui en ont fait la base de tant de systêmes, tout y seroit en repos. Les corps, tendant vers un centre commun, s' y accumuleroient et se rangeroient autour de lui en raison de leur pesanteur. Les matières qui composent le globe seroient d'autant plus pesantes qu'elles approcheroient davantage du centre, et celles qui sont à sa surface seroient mises de niveau. Le bassin des mers seroit comblé des débris des terres; et cette vaste architecture formée d'harmonies si variées, ne présenteroit bientôt plus qu' un globe aquatique. Tous les corps, enchaînés par une chute commune, seroient condamnés à une éternelle immobilité. D'un autre

côté, si la loi de projection qui sert à expliquer les mouvemens des astres, en supposant qu'ils tendent à s'échapper par la tangente de la courbe qu'ils décrivent; si, dis-je, cette loi avoit lieu, tous les corps qui ne sont pas adhérens à la terre, s'en éloigneroient comme les pierres s'échappent des frondes; notre globe lui-même obéissant à cette loi, s'éloigneroit du soleil pour jamais. Tantôt il traverseroit dans sa route infinie, des espaces immenses où on n'aperçevroit aucun astre pendant le cours de plusieurs siècles; tantôt, traversant les lieux, où le hasard auroit rassemblé les matrices de la création, il passeroit au milieu des parties élémentaires des soleils, agrégées par les lois centrales de l'attraction, ou dispersées en étincelles et en rayons par celles de la projection. Mais en supposant que ces deux forces contraires se soient combinées assez heureusement en sa faveur pour le fixer avec son tourbillon dans un coin du firmament, où ces forces agissent sans se détruire, il présenteroit son équateur au soleil avec autant de régularité qu'il décrit son cours annuel autour de lui. On ne verroit jamais résulter de ces deux mouvemens constans cet autre mouvement si varié, par lequel il incline chaque jour un de ses pôles vers le soleil, jusqu' à ce que son axe ait formé sur le plan de son cercle annuel un angle de vingt-trois degrés et demi, puis cet autre mouvement rétrograde, par lequel il lui présente avec la même régularité le pôle opposé. Loin de lui offrir alter-

nativement ses pôles, afin que sa chaleur féconde en fonde les glaces tour-a-tour, il les tiendroit ensevelis dans des nuits et des hivers éternels, avec une partie des zones tempérées, tandis que le reste de sa circonférence seroit brûlée par les feux trop constans des tropiques.

Mais quand on supposeroit, avec ces lois constantes d'attraction et de projection, *une troisième* loi versatile qui donne à la terre le mouvement qui produit les saisons, et *une quatrième* qui lui donne son mouvement diurne de rotation sur elle-même, et qu'aucune de ces lois si opposées ne surpassât jamais les autres, et ne la déterminât à la fin à obéir à une seule impulsion; on ne pourroit jamais dire qu'elles eussent déterminé les formes et les mouvemens des corps qui sont à sa surface. D'abord, la force de projection ou centrifuge n'y auroit laissé aucun de ceux qui en sont détachés. D'un autre côté, la force d'attraction ou la pesanteur n'eût pas permis aux montagnes de s'élever, et encore moins aux métaux qui en sont les parties les plus pesantes, d'être placés à leurs sommets, où on les trouve ordinairement. Si on suppose que ces lois soient l'*ultimatum* du hasard, et qu'elles se soient tellement combinées qu'elles n'en forment plus qu'une seule; par la même raison qu'elles font mouvoir la terre autour du soleil, et la lune autour de la terre, elles devroient agir de la même manière sur les corps particuliers qui sont à la surface du globe. On devroit

voir les rochers isolés, les fruits détachés des arbres, *les animaux qui n'ont point de griffes, tourner autour de lui en l'air,* comme nous voyons les parties qui composent l'anneau de Saturne tourner autour de cette planète," &c.—*Etudes de la Nature.* T. 11. p. 304, et suiv. Again, "Newton, ne pouvant goûter les tourbillons de Descartes, et sentant combien leur existence étoit impossible, établit un *viude immense,* dans lequel il prétendit que les astres faisoient leur course, sans que rien s'y opposât. Les planettes avoient leurs revolutions dans différens circles autour d'un même centre, et les comettes faisoient les leurs dans des cercles inégaux, excentriques, and différemment dirigés. Ce systême étoit simple, aisé à comprendre; mais *il parut impossible à bien des physiciens.* Ils objectèrent qu'il étoit impossible qu'un corps conservât toujours le mouvement circulaire sans une cause particulière, parce que tout corps, dès qu'il est libre, ou qu'il n'est point arrêté par d'autres corps, enfile une ligne droite qui l'éloigne du centre de son mouvement, par cette loi reconnue par tous les philosophes dans l'œconomie de l'univers. Les planettes dans le systême de Newton, devoient depuis longtems, n'avoir plus leur mouvement circulaire; elles auroient décrit, selon la loi ordinaire, une ligne droite, et seroient allées s'abîmer et s'anéantir dans quelques étoiles fixes. Ces difficultés vous paroîtront assez considérables: vous en verrez bien

d'autres tout à l'heure; mais dans quel systême ne s'en rencontre-t-il point? *Elles n'embarrasserent point le Philosophe Anglois.*"—" C'est cette pesanteur, ou cette attraction mutuelle, qui seule est cause de la régularité des mouvemens célestes et de toutes les merveilles, qui jusques aujourd'hui avoient paru devoir être toujours des mystères impénétrables.

Malgré cette attraction, si nécessaire au systême de l'Anglois, et qu'il avoit créé si àpropos, ses adversaires prétendirent que même en accordant qu'il y eût dans les corps cette puissance de s'attirer mutuellement, il seroit impossible qu'elle fût la cause de la régularité des mouvemens célestes, puisque la pesanteur donnant aux astres une tendance qui les dirige sans cesse vers le centre de leur révolution, ils dévroient s'y être réunis depuis longtems et avoir été consumes par le soleil, dans lequel ils se seroient précipités.

Cette réflexion parut un peu embarrassante à l'Anglois; *mais il se servit encore du droit qu'il avoit de créer.* Il donna une seconde direction aux astres; l'une perpendiculaire, causée par l'attraction qui les portoit au centre de leur révolution, et l'autre horizontale, qui les en éloignoit. Ainsi les astres, forcés de se prêter à ces deux directions différentes, ne pouvant suivre entièrement l'une des deux, furent obligés de partager le différend, et prirent le parti de décrire un cercle. *Si l'on eût*

encore contrarié l'Anglois, il eût donné encore une troisième direction aux globes célestes, et une quatrième même, si son système en eût eu besoin."* Thus it must be admitted, even by his greatest admirers, that notwithstanding his extraordinary merit, Newton was *a fortunate man;* for, were it not that the laws of movement were previously discovered by Kepler, and that his theory of attraction, agreeable to the law of the *inverse square,* was found to be in accordance with the facts in reference to the movements of the heavenly bodies, it will readily appear, that such and so numerous were the difficulties connected with it, that it had long since shared the same fate of its predecessors. And, in reference to these, the two pillars on which it reposes, and which despite the grave objections noticed have, up to our times, succeeded in upholding its credit:—possessed of the discoveries of Kepler, as admitted by D'Alembert, it was not at all necessary to suppose *a principle* of movement such as that of attraction, in order that the various facts connected with the movements of the planets, should be found in conformity with calculation. The latter having gone so far as to say, that instead of its being necessary or useful, the circumstance of admitting or taking into account the existence of such an agency, rather served to *embarrass* calculation, which did not stand

* Voyez *Philosophie du Bon-Sens.* T. 11, p. 471, et suiv.

in need of any such, than to simplify it; and, as regards the law of *the inverse square of the distances*, the *moteur*, or cause of movement, whatever it might be, *could only act on the planets conformable thereto.* The action of the other primary forces, as connected with the sun and planets, the same as that of gravity, being, as noticed elsewhere, governed by exactly the same law; and thus it will be seen, as stated, that the utmost that can be said of the Newtonian theory is, that its author was fortunate in having been preceded by Kepler, as, without the assistance of his discoveries, combined with the law of the inverse square, the theory of universal gravitation could no more have maintained itself, or borne the test of scrutiny, than those of Gassendi or Descartes; being, in reality, "though a little louder, yet as empty quite," as the theories proposed by these philosophers, in reference to the true principles and system of nature. And thus, "comme *le vrai seul, a des succès durables;*" and, as being a consequence, that this so celebrated a theory cannot be expected to hold its place much longer; the observation applied to the corpuscular system by St. Pierre, in the last century, will most probably be found equally to apply to that of universal gravitation in the next, viz. "Une de nos méthodes les plus ordinaires, lorsque nous saisissons quelque effet dans la nature, c'est de nous y'arrêter d'abord par foiblesse, et d'en tirer ensuite, par vanité, un principe uni-

versel. Si après cela on trouve le moyen, qui *n'est pas difficile,* de lui appliquer un théorême de géométrie, un triangle, une équation, seulement un $a + b$, *en voilà assez pour le rendre à jamais vénérable.* C'est ainsi que, le siècle passé, on expliquoit tout par la philosophie corpusculaire, parcequ'on s'étoit aperçu que quelques corps se formoient par intussusception ou par agrégation de parties. *Un peu d'algèbre qu'on y avoit joint, lui avoit donné d'autant plus de dignité,* que la plupart des raisonneurs de ce temps-là n'y entendoient rien du tout. Mais comme elle étoit *mal rentée,* elle n'a pas subsisté. On ne parle seulement pas aujourd'hui d'une foul de savans et d'illustres, que l'Europe combloit alors d'éloges."—*Etudes de la Nature,* T. II, p. 18.

Notwithstanding the length of these extracts, I thought them not uncalled for in this place, in order to show, however numerous its partisans, the little satisfaction given, or conviction produced, by the Newtonian theory of universal gravitation, even in regard to the few phenomena which it pretended to explain:—and the consequent necessity which existed for substituting a theory in its place, which, from being more comprehensive in its bearings, and more in conformity with the march of discovery in the other departments of science, by taking in *the whole* of the phenomena of nature connected with the heavenly bodies, would, if successful, leave nothing further to be sought for or desired in reference to this

grand department of physics; and, as in all cases a certain proportion should exist between the means employed and the ends proposed, things could not well be otherwise than as we find them, in reference to the theory of universal gravitation. For, as the principle which served as the basis of this theory, was but *relative,* as regards the phenomena of the heavenly bodies, and *superficial* from being itself, as I hope to show, no more than *a member* derived in common with others, from a more remote and comprehensive law, or primary *first cause,* and not being (as should have been the case, if correct,) itself such first cause: but, as regards natural phenomena, extremely limited in its range; how, I ask, were it possible, that a theory based on a principle such as this, could have been right?

This premised, we shall enter on an examination of the principles assumed by that by which it is proposed to be substituted.

CHAP. V.

Gravity, its assumed Source and Nature.

And first, as to Gravity. It is an assumption of our theory, that, as refers to the earth, sun, and remainder of the heavenly bodies, this force is, in every instance, of home growth, and, consequently, is al-

together local in its range; being esteemed as not only connected with magnetic and electric action in their atmospheres, but absolutely *derived from it.* To understand this, however, it becomes necessary to enter a little into details.

In the first place, it is an assumption of our theory, however opposite to the Newtonian, that *there is no vacuum in nature,* this being, as will be recollected, in accordance with the most recent observations. That, as connected with the heavenly bodies, the matter of which they are composed is of opposite kinds, viz. *solid* and *æriform*, of which the element of water may be considered the bond, or connecting link: and that there exists a still further division of it into *solar* and *planetary*, being in each case, though differently, an exemplification of the law of *the union of opposite progressions of the same nature;* and of which, as water in the former, the *æriform portion of this matter,* as connected with the sun and planets, is the connecting link, equally as the seat of the active forces of nature connected with their temperature and movements. These the active forces of nature connected with the sun and planets, are but *two* in number, or, as the bodies themselves, of *opposite kinds,* viz. *magnetism* and *electricity*, whose local agency, whether as connected with their temperature or movements, is based on the principle of *reflective action,* i. e. the action of the sun as reflected by the planets, and

the action of the planets as reflected by the sun and by each other: this, according to our theory, being the primary or *first cause.* That these the active forces of nature are locally united in the atmospheres of the sun, and remainder of the planets, equally as in that of the earth; being, as in the preceding cases, still a repetition of the primordial law of the union of opposite progressions of the same kind—planetary and solar *heat,* together with the *rotary movement* of the sun and planets, having, as assumed, their source in *electric action:*—planetary and *solar cold,* together with the elliptical movement of the planets, having their source in *magnetic action.* And which, as being esteemed the next in the order of succession, brings us to the subject of *gravity.*

In reference to the latter action, I shall, in the first place, observe, that dissimilar to electricity and magnetism—with the exception of the variations of the barometer, we have no proof that gravity is connected with the active forces of nature in the atmosphere; but that, as it is only by the presence and agency of a *homogeneous force* in the latter, that the action of gravity, as shown by the changes of the barometer, *could be affected:* the existence of these changes shows that a connexion does subsist between the action of gravity and that of the active forces of nature, or electric and magnetic action in the atmosphere. And finally, that this the

action of gravity in the atmosphere consists in an *attractive force* exerted on all *ponderous* bodies, (and in proportion to the degree of their *ponderosity*,) from the various points of *a circle*, which surrounds the earth on all sides, to a common centre beneath, like inverted rays; but of the circumference, or exact position of whose extreme superficies we are totally ignorant; being only aware, from the progressive falling off in the amount of gravity, as we ascend from the surface or mean level of the earth, as shown by the barometer, that its force is greatest at, and in the vicinity of the latter; and that it cannot extend either to the sun or moon: as if so, divesting ourselves of the jargon of the schools, the effect of gravity on these bodies, the same as on others within its range, had long since consummated the junction of their masses with that of the earth.

It is further necessary to observe, that, independent of the variations of the barometer, *experiment*, as in the instance of the *helix*, shows that an intimate connexion exists between gravity and the action of the electrical and magnetic forces. And which experiment with the helix, as it may not be known to the generality of persons, and that I consider it of no small importance as connected with the present inquiry, I think it right to insert an account of in this place, as copied from Mrs. Somervill's work "On the Connexion of the Sciences," page 347,

viz. "If a magnetised steel bar, or needle, be placed within the screw, so as to rest upon the lower part, the instant a current of electricity is sent through the wire of the helix, the steel bar *starts up* by the influence of this invisible power, *and remains suspended in the air in opposition to the force of gravitation:*" and further,—"the effect of the electro-magnetic power exerted by each turn of the wire, is to urge the north pole of the magnet in one direction, and the south pole in the other," and thus "it acts as if it had a north pole at one extremity and a south pole at the other, and is attracted and repelled by the poles of a magnet, exactly as if it were one itself." It may be proper to add, in regard to this and other similar experiments connected with electricity and magnetism, that *the laws* which govern these the assumed universal agencies of nature, are as accurately expressed on the most contracted scale of experiment, as on those gigantic theatres of their activity—the masses of the sun and planets. An illustration of this is furnished by a magnetised bar, for instance, which though it be twenty feet long, will not, with greater accuracy, exhibit the attractive and repulsive forces of its opposite poles, than will the smallest fractional part of the same bar, when detached from the remainder, exhibit, at its opposite extremes, the same phenomena, repulsive and attractive. This observation being equally applicable to experiments connected with the laws

which govern electrical and magnetic currents, whether separately or combined; and which, by submitting the manner in which these laws operate in the great theatre of Nature so correctly to our view, enables us to make their application with the utmost certainty, both as refers to the temperature and movements of the heavenly bodies, equally as to the connexion which subsists between electric and magnetic action and that of gravity. And deprived of which conformity in the laws by which the electric and magnetic forces are governed, whether separately or combined, thus obtained, it were vain to hope we should ever have arrived at the knowledge of.

But, to resume. In making the application of the experiment of the helix—as in the preceding allusion to the variations of the barometer it was stated, that they could only be induced by means of corresponding changes occurring in the action of homogeneous forces in the atmosphere, to those in which gravitation has its source. This, the experiment of the helix, not only proves more fully that such is the case, but goes still further, in showing the nature of, or in what these forces consist, viz. *in the union of electric and magnetic action* in the one case, equally as in the other. And further, that an increased energy in the combined action of the electrical and magnetic forces to that which exists in the atmosphere, thus artificially produced, and

brought to bear *circularly*, as in the atmosphere, on a body placed within its vortex, has the effect of superseding the action of terrestrial gravitation on such body, viz. by *originating this the force of gravitation artificially, and attaching it to a different or local centre,* and thence of giving, as we perceive, to the body so acted on, the same *polarities* as the earth, being, in all respects *a miniature representation of the manner in which these, the three primary forces of gravity, magnetism,* and *electricity, act individually on the different members of the solar system.* And thus, I conceive, we are warranted in concluding that, as stated, gravity, whether in the sun or planets is *a local action;* that it is derived from electric and magnetic action in the atmospheres of these bodies; and in each may be defined to be the *contre-coup*, rebound, or reverberation collectively, of the combined action of the electrical and magnetic forces in the atmosphere, excited, sustained, and perpetuated in that of the earth and remainder of the planets, by their *reflection of the solar action;* as in the sun, *by its reflection of the planetary action,* or probably of a more distant centre; thus concentrated on their masses beneath, or on the plains of its projection, their reflecting surfaces. These the opposite and mutually controlling actions locally in the sun and planets, originating in the principles of *reflection*, as refers to the collective amount of electric and magnetic ac-

tion in the atmospheres of these bodies respectively, on the one hand, and that of gravitation on the ponderable matter of their masses on the other, being in each particular case esteemed to be equal, i. e. that they are the sum of, and mutually balance each other, they being, as in the preceding cases noticed, still illustrative of the primary disposition of nature—the union of opposite progressions of the same kind. It will follow, in reference to gravity, that the action of this force in the earth and remainder of the planets, (as being derived from the solar action,) has its source in the sun; and contrariwise as regards the latter: and consequently, that its *direction* in these bodies must be opposite, from its being reversed on the lines by which they are separated; it being one of the characteristics of electric and magnetic action that it begets directly opposite forces, attractive and repulsive, at one and the same time. And consequently, as refers to the bodies which compose the solar system in their collective relations, that the action of gravity cannot, as had been supposed, be attractive; but must, on the contrary, be *a repulsive action*. And as, on the principle of reflective action, the individual force of gravity in these bodies, must, in each case, be proportioned to the size of the reflecting surface from which it is derived, and that, as being its counterpart, the *repulsive action* it induces, in reference to the sun, must be proportioned thereto; and, conse-

quently, that it must *be greater in the superior* and *less in the inferior planets* proportioned to their size.

Thus we are led to perceive the principle on which the order and harmony subsisting between these bodies and the sun, and between each other, in the ecliptic, is founded; the smaller planets, owing to the amount of this repulsive force between them and the sun, *being less, approaching nearer;* whereas those of larger size, from this repulsive action being, as their masses, *greater,* range at so much greater distances than the former, proportioned to the amount of such difference. The correctness of this principle generally, it may be added, or considered as a rule, being borne out by the positions occupied by the primary planets in reference to the sun, as by the secondary in their relative positions in reference to the primary planets round which they revolve.—"Dans les sphères célestes," observes *St. Pierre,* "si le centre appartient naturellement aux corps *les plus considérables,* comment se fait-il que Saturne et Jupiter, qui sont beaucoup plus gros que notre globe, *soient à l'extrèmité de notre tourbillon?*"—*Etudes de la Nature.* T. 11, p. 8. The reason of this, as refers to the positions of Saturn and Jupiter, is sufficiently evident according to the doctrine of *repulsion,* as stated, but cannot be accounted for on any other principle; showing, as elsewhere observed

by the same author, that, in this as in other instances, Nature "*n'agit que par des réactions.*"

Thus, to recapitulate. It will, I hope, appear to be satisfactorily proved by the preceding statements and observations, that the *active forces* of nature are no more than *two in number*, viz., electricity and magnetism; and that, considered in their relation with the *primary cause* on which this the principle of their activity is based, on the one hand; and as in its turn based on the latter or local activity of these forces in the sun and planets—with the force of gravity on the other. In the connexion subsisting between these, the three primordial *columns*, as they may be called, or sustaining principles of nature, on which the whole of her creations and dispositions in the physical world are based; *reflective action* considered as the primary, or *first cause*, necessary holds *the first place;* electric and magnetic action *the second;* and finally, considered as being derived locally from the latter, *gravity* can only be assigned *the third* or last place in this the scale of their relations.

CHAP. VI.

MAGNETIC ATTRACTION *esteemed the Moteur or Principle in which the elliptical Movement of the Heavenly Bodies has its Source, and* ELECTRICAL AGENCY *to be that of their Movement of Rotation.*

HAVING thus, as I hope, finally solved this so long disputed problem, and assigned its true place in astronomy and physics to the primary force or principle of *universal* gravitation; it will appear, that though the local bond of union between the elements which compose the sun and planets, and immediately derived from the active forces of nature in their atmospheres; *gravity*, as already noticed, can have nothing to do with the principle of their *movement*. And that, as the *repulsive action* between the sun and planets which grows out of the *reversed action of gravity* between these bodies on the lines of distance by which they are separated, if not controlled *by an opposite*, would have the effect of removing them continually farther, one from the other, so as finally to dissolve all connection between them. Assuming that the same local division and distribution of magnetic action exists equally in the sun and remainder of the planets as in the earth,

in extending from their equators to opposite poles. In the principle of *attraction* which, as is known, exists between magnetic poles of *opposite names*, as to its true source, we are enabled to discover the *controlling force* opposed by nature to the repulsive action of these bodies on each other alluded to. And further, that, together with thus making *magnetic attraction* the bond of union between the sun and planets, nature has likewise engrafted on it, as I hope to show, the elliptical movement of the primary planets round the sun, as of the sattellites round the primary planets to which they are attached.

In order, however, that as little as possible should be left to supposition or conjecture, and consequently, as relates to principles, that nothing should be advanced that was not warranted or borne out by experiment; it will, in the first place, be recollected that, as has been justly observed of it, one of the most important discoveries of modern times shows, that when electric and magnetic actions are combined, instead of their currents progressing, as might be supposed, *in the same line*, they, on the contrary, are found to move *à travers*, or to cross each other at right angles; and, secondly, that each of these forces, when so combined, is found to be capable of imparting, and consequently of being the spring or source of *a circular* or *rotary movement* to certain bodies, when they are brought to act on

them. Keeping these facts in view, the next circumstance which it becomes necessary to notice is, that as the force of gravity individually, whether on the mass of the sun or on those of the planets, is, according to our showing, exactly balanced by the amount of electric and magnetic action in their local atmospheres; that, as being a consequence, these the active forces of nature, assuming them to be the source of movement in these bodies, are, agreeable to the disposition established between them, the sun and planets, equally capable of *producing*, as the conformity which exists between the *local direction* of the action of these forces, when, as in the atmospheres of these bodies, combined; with those of the opposite movements of the planets round the sun and round their axes, *fit them* for being the sources thereof. Which, it may be added, if shown to be the case, will, it is hoped, satisfy all rational minds that the so long sought for knowledge as to the source of movement in the heavenly bodies is at length obtained.

Assuming, then, that the action of gravity on the mass of the sun, as on those of the planets, is the counterpart of the action of the electric and magnetic forces in their atmospheres: and consequently, that these opposite actions locally in the sun and planets mutually balance and neutralize each other; the effect on these bodies, notwithstanding their enormous dimensions, must be to render them, indi-

vidually, equally *buoyant as air-bubbles* in the positions they occupy in the ecliptic; and consequently in a state which fits them to obey the slightest impulsions received from without.

And if in the mutual or *collective* relations of these the heavenly bodies, that a similar equalization of the electric and magnetic forces existed between them, as *individually* between the latter and the force of gravity; the effect necessarily would be, that though endued with the principles of movement, as in the case supposed, the magnetic attraction of the sun on the planets, individually, were balanced by the magnetic attraction of the latter; and its electric action on them, if in like manner balanced by electric action of each of the planets, would be similarly neutralized; the consequence would be, that, as referred to either action, between the sun and any one of these bodies, *it could not originate movement in the latter*; and that in such case *a state of rest* must ensue.

But assuming, in the first place, that nothing is detached in nature; and that the relative force of electric and magnetic action in the sun and planets, is generally *as their magnitudes;* we are thence enable to see, that from the great centre wheel of the solar system, to the smallest of the satellites—as the *smaller body* in every case revolves round *the larger*—that the whole shows such a graduated scale of forces and relative dependance, as, on the

principles assumed, instead of rest, must have induced a state of movement throughout the entire of its planetary members.

But as connected with the orbital movement of the planets, it becomes necessary to notice the collision of opposite actions therein; for, as the magnetic attraction of the sun on the planets, if unchecked, would cause them to approach directly to the sun; and that its opposite, the action of *repulsion* between the sun and planets, if, in like manner uncontrolled, would cause the latter to move off in right lines from the sun. It follows, in the first place, that it must be the sum of these opposite actions of the sun on the planets, which confines them respectively in their orbits; and though, in order to impart movement, the magnetic attraction of the sun on the planets, must be superior in force to the opposite action of repulsion; the movement it imparts, owing to its being to a certain extent opposed by the latter action, cannot be precisely *in the direction of the sun;* but, as being made up of opposite forces, must be a movement that partakes of each; and consequently describes the sum or measure of both. And which thence, proportioned to the greater or less difference in the relative amount of these actions individually on the planets, must approach more or less to that of *a circle*, i. e. the more nearly these opposite forces are balanced, the more the movement of the body acted on must approach

to the figure of *a circle*; and the more unequal the amount of these opposite actions, the more the movements of the body acted on must deviate from the circle, and approach to the figure of an *ellipsis*.

But if the magnetic attraction of the sun on the planets were, as assumed, the source of the elliptic-tical movement of these bodies, it is easy to see that this were not the only movement which the solar action on the planets would induce. For, assuming the solar action on the planets to be *electrical*, equally as magnetic; the former action of the sun, equally as the latter, would impart a movement to them peculiar to itself; and which, as the direction of its electric action differed from that of its magnetic, would necessarily cause this latter to differ from the elliptical movement of these bodies; or to be, as the direction of the action which induced it, at right angles with the latter. And as, besides the elliptical, no movement remained to be given to the planets but one round their axes; that this the electric action of the sun on these bodies, would, at the same time that its magnetic action imparted to them their orbital, necessarily impart to them *a movement of rotation*. And consequently, that such a division of the electric and magnetic forces in the sun and remainder of the planets, as that which we observe in the earth, must have the effect of inducing movements in the latter bodies exactly equal to those they have.

But however correct these assumptions, in order to understand the manner in which the principle of magnet attraction in the sun acts in inducing the orbital movement of the planets, it becomes necessary to enter a little more particularly into details; which is the more desirable, as it will necessarily lead us to a nearer view of the intimate connexion which exists between the twin sciences of astronomy and meteorology, arising out of the species of common identity that subsists between the principles of both. Thus, as connected with the elliptical movement of the earth and remainder of the planets, assuming that the same division of magnetic action, locally, exists in the sun and remainder of the planets as in the earth, in converging from their centre to opposite poles, situated on, or in the vicinity of the opposite extremes of their axes of rotation. And that, as magnetic poles of the *same name* do not attract, but on the contrary *repel each other;* and thence that such attraction can only exist between poles of *different names;*—as being a consequence, in order that the magnetic attraction of the sun on the planets should induce in the latter bodies their orbital movement, it became necessary that these the magnetic poles of the sun were *reversed* in their position to those of the planets. And as, from the nature of magnetic attraction, that no more than *one* of the magnetic poles of the sun—at any time—could act on the orbital movement of the earth or other of

the planets; and this only by means of its attraction of the magnetic poles of the latter that were of *a different name;* i. e. that this the elliptical movement of the earth, &c., could only be upheld by means of the attraction of the magnetic pole of the *southern hemisphere* of the sun, on the opposite, or magnetic pole, of the *northern hemisphere* of the earth, or other planet, while the latter was traversing the *northern* division of its orbit; and by the attraction of the opposite or magnetic pole of the *northern hemisphere* of the sun, on the magnetic pole of the *southern hemisphere* of the earth, while the latter was traversing the *southern* division of its orbit.

And thus, as connected with this the elliptical movement of the earth and remainder of the planets, that these the opposite and *acting* poles of the sun, and earth, &c., would during the period of six months, or one half their orbital course, consecutively, *be active;* while their opposite magnetic poles continued *passive*: and thence with the change in the relative position of these bodies in the ecliptic, that during the remainder of their course, the latter would become the *active,* and the former, the *passive* magnetic poles of the sun and planets: and so alternately.

Now, if, similar to the lunar circle, we divide the annual, by *syzygies* and *quadratures;* the former will necessarily correspond to its *equinoctial,* and

the latter to its apsides or solstial points: and that the periods at which the changes in the site of the magnetic attraction of the sun between the opposite poles of the earth take place, are those of the syzigies; when, after traversing one half the ellipsis in which it moves round the sun, the earth is in the act of passing on to its opposite division.

It follows, as will presently appear, that these the earth's syzigies or equinoctial periods are those of the *least*, or *minimum* force of the magnetic action of the sun on either pole of the earth. And, on the contrary, that the periods of the *maximum* force of the magnetic action of the sun, collected on the pole and remainder of the *winter hemisphere* of the earth are those of its quadratures; when the distance of of the *acting* magnetic pole of the sun, from the corresponding or winter pole of the earth, is greatest. Let us now suppose the earth in *quadrature* with the sun, at the period of the solstice; when, together with the *greatest distance* between the acting poles of the sun and earth, (i. e. the southern pole of the sun with the northern pole of the earth at the period of its perihelion, or that of our winter solstice,) the magnetic action of the sun on our winter hemisphere is assumed to be the greatest. It would follow, that the greatest force of the magnetic attraction of the sun on the earth occurred exactly at the part of the earth's orbit, where, in order to change the direction of its path in the heavens, it was the

most requisite. And that, having effected this object,—the continually increasing impetus thence given to the movement of the earth, from the solstice to the period of the vernal equinox, incident to the uninterrupted *pull* during the intervening three months, imparted to it by the acting pole of the sun, would be such as to cause it, the earth, to continue its orbital course from the period of the equinox to that of the succeeding solstice at its aphelion. But as with the change in the relative positions of the earth and sun in the ecliptic at the period of the vernal equinox, that the site of the magnetic attraction of the latter on the earth, would change from the pole of its approaching summer, to that of its approaching winter hemisphere. Thus, by means of the gradual increase in the force of this attraction of the sun, with the gradual elongation of the earth in its approach to the apside or period of our summer solstice—an opposite and controlling force on its orbital movement would thus be generated: which controlling force, together with lessening the rapidity of the earth's movement, would have the effect of gradually changing the direction of its path in the heavens, till, having finally arrived at the period of the solstice, and extreme limit of the earth's orbit, and, at the same time, at the period of the maximum action of the northern magnetic pole of the sun, on the southern or winter pole of the earth: the force of impulsion given to the latter, from the period of

the preceding solstice to that of the vernal equinox, and which, as assumed, continued to impel and influence its movement to this point of its orbit—being here *balanced* with the force of resistance thus opposed to its further advance by the increased attraction of the sun; and which would have the effect, necessarily, of modelling the direction of its course, and of consigning it anew to the full operation of this the maximum attraction of the sun.—Together with a total change of direction in its path, the earth would recommence anew its annual course, from the same point of the heavens as before, in the direction of its *perihelion*, or the opposite extreme point of its orbit: and *vice versâ*.

Thus far in reference to the assumed connexion of magnetism with the elliptical movement of the earth and remainder of the planets. And, in reference to the assumed connexion of magnetic action with the temperature: as the *greatest cold*, as stated at the commencement of these observations, is known to occur at or in the vicinity of the magnetic pole, or poles, of the winter hemispheres of the earth; and at or after the period of the maximum force of the magnetic action of the sun on the latter. It would follow, however new and seemingly paradoxical, that not only the greatest *heat* of summer,—as being an effect of the extreme annual concentration of the *electric action* of the sun on the summer hemisphere of the earth collected on

its tropical regions; but *the greatest cold* of winter, as being a similar result of the extreme annual concentration of the *magnetic action* of the sun, collected in the vicinity of the magnetic poles of the winter hemisphere, is likewise an effect of the *solar action.* These the effects of the opposite actions of the sun—electric and magnetic—on the temperature, being varied continually in their amount in the annual circle, with that of the co-operative action of the external planets, equally as of the moon, incident to the changes which are continually taking place in the relative positions of these bodies in reference to the sun and earth. This the principle of planetary temperature—similar to the numerous instances already cited—being a new and most important result and illustration of the fundamental law of *the union of opposite progressions of the same nature,* in the sun and planets. Which, from their great source and centre in the sun, extend and develop these their effects in the most distant, equally as in the nearest of the planetary train by which he is surrounded. There is this remarkable difference, however, observable between the action of the electrical and magnetic forces of the sun on the temperature and movements of the planets, viz. that whereas the relative force of the electric action of the sun on the temperature and rotation of the planets, other circumstances being the same, is as *the inverse ratio of the squares of the distances*

from the sun, and of its approach to a *vertical direction* on the atmospheres of these bodies;—the relative force of the magnetic action of the sun on the temperature and elliptical movement of the planets, is, on the contrary, in *the exact ratio of the squares of the distances*, and *of the obliquity of its direction* on their atmospheres:—being thus in all respects opposite both in the manner of its action, as in its effects on the planets, as contrasted with electric action.

And here I should dismiss this part of our subject, but that there are some other circumstances which, as being still further illustrative of the admirable dispositions of nature in the heavenly bodies it becomes necessary to notice. viz. in the first place, that, as connected with the movements of these bodies, the positions of the sites of the local foci of magnetic action, situated as they are at the opposite extremes of their axes of rotation, and by means of the solar action on which, as assumed, their elliptical movement is induced; could not, on the most strict *mechanical principles* have been more judiciously selected in order to the attainment of this the object proposed; being, as they are, exactly *in the line of its direction*, equally as at the points of their superficies where the solar attraction on this movement would induce the greatest possible effect; the same observation being equally applicable to the eclectrical action of the sun in its assumed connexion with their move-

ment of rotation; from the line of this action of the sun, similar to the former, in crossing the magnetic meridians of these bodies at right angles, being equally in the direction of this movement; and from its greatest force being collected on the zones at their centres, which encompass their tropical regions, being, as the former action, applied on the parts of their superficies, where, in reference thereto, it would necessarily produce the greatest effect. In the second place, it was impossible that any other disposition of the primary forces in the sun or planets, whether considered in reference to their *local* or *foreign relations*, could have been so perfect as the one which we find established; possessing, as it does—from its chief source *reflection* being local—the double advantage of the greatest possible energy on their masses, both as connected with the principle of gravitation, on which their existence is based, or with that of their temperature and other local phenomena; and, converted as this local energy in these actions is, to be the means of inducing in the bodies acted on, the most perfect *buoyancy* or freedom, that they might the better respond to the impulsions they receive from without, connected with their movements, elliptical and rotary,—as of acting *in the distance* on the latter. And finally, as the amount of gravitation on the masses of the planets, is assumed to be the measure of the mean local action of the electric and magnetic forces in their at-

mospheres; and that the *movements*, equally as the temperature of these bodies, are assumed to be in a ratio proportioned to these local actions: as these the mean local actions of electricity, magnetism, and gravity in these bodies are invariable; we are thence enabled to trace, as to its source, the cause of that unchanging harmony in their movements, which, from the earliest records of time to the present, as observed by La Place, has not varied, probly, by so much as a second of time.

CHAP. VII.

Comets.—Satellites.

A WORD, in addition, on the subject of *comets*, and I am done. After all the consideration I have been able to give to the subject, comets appear to me to belong to the class of bodies known by the name of *meteors*, and that the only way we can rationally account for the movement of comets is, to suppose that similar to the larger class of globular meteors, they are, to a certain extent, endued with an *inherent force of movement*, governed, however, in some degree, and controlled by the action of the sun and planets. For, on these principles only—as appears to me—and in our supposing that, similar to meteors, they are susceptible of undergoing rapid

and important changes in their configuration, can we, on scientific grounds, account for the changes, in their appearances, which they so frequently exhibit, equally as for the astonishing velocity of their movements, and the eccentricity of their orbits.

In reference to the secondary planets, or *satellites*, they exhibit the singular spectacle of a class of bodies, the sources of whose movements—elliptical and rotary—are, as it were, equally divided between their *principals* and the *sun;* the former, or orbital movement of satellites being derived from the magnetic action of the primary planets to which they are attached; while the latter, or movement of rotation round their axes, is an effect of the electric action of the sun, the same as that of their principals. And were it not that satellites exhibit *phases*, I should be inclined to suppose, particularly as refers to the more distant of the superior planets, that their meteoric action partakes more of the nature of that of the *sun*, than of the ordinary class of planets. And that it was by means of such a partition and local combination of the opposite actions—solar and planetary—Nature had provided a compensation or counterpoise, for the falling off in the force of the solar action on those distant planets; and that an approximation in the principle of their temperature with those situated nearer the sun, and a similarly quick rotation of the seasons, as in the latter bodies, notwithstanding the great extent of their orbits,

was effected. And, as further illustrative of the assumed principles, repulsive and attractive, proportioned to their magnitudes, which exist between the heavenly bodies, in those of the superior planets, as *Jupiter*, *Saturn*, and *Uranus*, which have the greatest number of satellites attached to them;—the same order in the scale of their distances from their principals, as between the primary planets and the sun, will, I apprehend, be found to exist equally in the former case as in the latter, viz. that the smallest approach nearest, and that the largest range at the greatest distances from these, the central orbs, round which they revolve. And thus, as has been already observed, both by me and others, that each of these bodies so attended by their satellites, is, to a certain extent, a miniature representation of the solar system: which, did the latter bodies, as suggested, partake more of the *solar* principle than the primary planets themselves, would cause such resemblance to be still greater; as the only difference would then consist in the circumstance, that these the opposite principles, solar and planetary, as connected with the solar system, and these minor representations of it, were locally reversed. Be this, however, as it may, we risk nothing in assuming, that unless some essential object in the economy of nature had to be attained by, and was connected with the presence of satellites, equally as with the rings of Saturn, they

would not have been added to the primary planets to which they belong.

CHAP. VIII.

Rain;—its diminutives Fog and Dew, and accessory Phenomena.

Thus having, in this rapid sketch, as I trust, exhibited the sources of planetary movement, and shown the identity which, as assumed, subsists between them and those from which the principle of temperature in these bodies is derived, and the intimate connexion of meteorology with astronomy; and, for the first time,—by tracing its source to electric and magnetic action,—shown the real place occupied by *gravity*, in the economy of nature, and fallacy of the doctrine of *universal gravitation*, as applied to this the principle of planetary movement. We shall now resume the subject of inquiry from which we departed, viz. *as to the principle in which the formation of rain in the atmosphere has its source.*

Previous to the experiments in electricity, made about the middle of the last century, by the celebrated Buffon, by Dalibard, and De Romas in France, and by Franklin in America, the phenomena of the atmosphere were only considered and ex-

plained *on chemical principles;* but so numerous and unexpected were the lights thrown on this department of science by these experiments, that former opinions had to be abandoned, and, as marking the dawn of a new and more brilliant era in physics, an entire revolution therein was the result. "S'il est dans l'histoire des empires," observes Bertholon, "des époques brillantes, qui excitent l'admiration et l'étonnement, on en remarque quelquefois de semblables dans celles des sciences. L'expérience de Marly-la-Ville (par M. Dalibard,) sera à jamais célebre dans les fastes de la physique, et la météorologie depuis cette expérience fameuse a pris une nouvelle face. Autrefois on expliquoit tous les phénomenes, qui appartiennent à cette branche de la physique, *par le moyen des effervescences chymiques;** aujourd'hui ces *vieilles chimeras sont reléguées avec toutes les absurdités de l'ancienne école.*"† But, however considerable and important the results which, in the course of a few years, followed in rapid succession the opening thus effected: it was not until very lately that they extended to more than tracing the connexion between electricity and the phenomena of rain, lightning, thunder, and

* It is scarce necessary to observe, that the whole of the proofs proposed by Sir I. Newton, in reference to the theory of universal gravitation, were based on *chemical principles.*

† Voyez *De l'Electricité des Metéores,* par l'Abbé Bertholon, tome Premier, p. 4.

this class of meteors; as it had never entered into the minds of the philosophers of those times, that atmospheric temperature itself had its source in, or was connected with electric action. Even the celebrated Abbé Nollet, himself, who, as appears, had the honour of being the first to suppose the connexion of electricity with meteors, did not extend his views beyond this point, as the following passage, extracted from a work of his, published in 1748, entitled "*Leçons de Physique Expérimentale*," and which has been cited by Bertholon, in proof of this his prior claim to the honour noticed, will sufficiently show:—"Si quelqu'un, par exemple, entreprenoit de prouver par une comparaison bien suivie des phénomènes, que le tonnerre est entre les mains de la nature, ce que l'électricité est entre les nôtres, que ces merveilles dont nous disposons maintenant à notre gré, sont de petites imitations de ces grands effets qui nous effrayent, et que tout dépend du même méchanisme: si l'on faisoit voir qu'une nuée préparée par l'action des vents, par la chaleur, par le mêlange des exhalaisons, &c. est vis-à-vis d'un objet terrestre, ce qu'est le corps électrisé, en présence et à une certaine proximité de celui qui ne l'est pas; j'avoue que cette idée, si elle étoit bien soutene, me plairoit beaucoup; et pour la soutenir, combien de raisons spécieuses ne se présentent pas à un homme qui est au fait de l'électricité? L'universalité de la matière électrique; la promptitude

de son action, son inflammabilité et son activité à enflammer d'autres matières; la propriété qu'elle a de frapper les corps extérieurement et intérieurement jusques dans leurs moindres parties; l'exemple singulier que nous avons de cet effet dans l'expérience de Leyde; l'idée qu'on peut légitimement s'en faire, en supposant un plus grand degré de vertu électrique, &c. Tous ces points d'analogie que je médite depuis quelque tems commencent à me faire croire, qu'on pourroit, en prenant l'électricité pour modèle, se former, touchant *le tonnerre et les éclairs*, des idées plus saines et plus vraisemblables que tout ce qu'on a imaginé jusqu' à present." Thus, however easy the transition, and natural the inference, from their being members in common of the same family, it was not till the publication of the experiments of M. Donné with the zambonic, or *piles sèches*, in 1827, and by which the connexion of electricity with the changes of the temperature was fully shown, that the attention of philosophers was directed to the latter circumstance; but without its being productive of any immediate result. The subsequent experiments of Messrs. Christie and Cumming, in England, in thermo-electricity, carried this proof a stage farther, by showing, from the diurnal variations of the compass-needle, that *magnetic*, equally as electric action, is connected with the solar action, and variations of the temperature; till all further doubt as to the principle of atmos-

pheric temperature being the conjoint result of electric and magnetic action, excited by the sun, as assumed by our theory, appears to be finally removed. This backwardness in making the application of the discoveries in electricity available, towards explaining the source of planetary temperature, will, however, the less surprise, when, in turning our attention to the subject of the *formation of rain* in the atmosphere, the first circumstance that strikes us is, that the only explanation which even *now* is given of this operation of nature, is founded on precisely the same *chemical* principles of *evaporation* and *condensation*, as though the experiment at Marly-la-Ville, of Franklin, De Romas, &c. had never been made. This, it will be admitted, is the more remarkable, as of all meteors, the phenomenon of rain, from being that which, owing to the palpable nature of the connexion subsisting between it and electric action, first suggested the existence of this connexion, and which, from its being always associated with the phenomena of thunder, lightning, &c. is that in reference to which the least doubt can be entertained, as to its being, in its nature and source, electric. So far, however, is this from being the view of the subject taken by some of our leading *physiciens*, that in the following account of the formation of rain in the atmosphere, by the Rev. W. Whewell, extracted from his recent work on "Astronomy and General Physics, page 88, there

does not occur so much as an allusion to any such connexion, viz. *Laws of Heat—Water.*—"Clouds are produced by *aqueous vapour*, when it returns to the state of water. This process *is condensation*, the reverse of *evaporation*. When vapour exists in the atmosphere, if in any manner the temperature becomes lower than the *constituent temperature*, requisite for the maintenance of the vapoury state, some of the *steam* will be condensed and will become water. It is in this manner that the curl of steam from the spout of a boiling tea-kettle becomes visible, being *cooled down* as it rushes to the air. The steam condenses into a fine *watery powder*, which is carried about by the little aëriel currents. Clouds are of the same nature with such curls, &c." If this mode of accounting for the phenomena of clouds and rain does not savour more of "ces vieilles chimères, et absurdités de l'ancienne école," alluded to by Bertholon, than of the advances making in other departments of science, I must own, I neither know, nor can pretend to say what does; for as, notwithstanding the numerous discoveries in electricity bearing on the subject, no principle is introduced or alluded to other than *chemical;* it is such an explanation of these phenomena as might naturally have been expected at the time of Aristotle. Thus demonstrating, as the fact does, that meteorology, considered as a science, is not only not keeping pace with the advances making in other sciences,

but is rather in what astronomers would call a state of *retrogression:* for, as far back as the year 1787, being the period of the publication of his work already alluded to, Bertholon showed, by direct experiment, the connexion of rain with electric action. But, in order to prove the fallacy of the mode adopted by Mr. Whewell, of accounting for the formation of clouds and rain, it is only necessary to contrast the water obtained by distillation from sea water, with that which descends from the clouds: for whereas the latter, even at sea, is both limpid and sweet, all the art that has hitherto been applied to substitute it by distillation, filtration, &c. has, as is known, ended in failure. The reason of this is simple, viz. that, in the former case, sea water, or other, after undergoing the process of *decomposition*, by means of the solar action on the element beneath, and, consequently, of its being separated into its primitive elements, oxygen and hydrogen, and in this their separate and aëriform state, transferred into the atmosphere, where they enter into its composition, are subsequently, by means of an opposite species of meteoric action, re-united anew in the middle region of the air, and in this state returned to the earth in water, which thus, in order to its renovation, has to pass through a complete state of revolution; whereas, in the process of distillation, from no such decomposition of water having, in the first place, been effected, the condensation of it

from *steam* in this process, does little more than return it in its primitive state.

It is necessary to add, that one of the chief causes of the error fallen into by Mr. Whewell, and others on this subject, appears to be, that, as in the different attempts hitherto made to analyze atmospheric air,—dissimilar to oxygen,—*hydrogen* has not been found to exist in it in a state of combination; and thenee it has been inferred that the principle of rain, as to its source, is referable to the presence of what is denominated *latent moisture*, or *aqueous vapour* in the atmosphere. But do we not, in the different specific gravity of hydrogen, as compared with oxygen, find the cause of this, and why it were impossible that it could be otherwise? viz. that in its pure or detached state, owing to its want of specific gravity, and comparative lightness, it were impossible for hydrogen to remain suspended in the same volume of air with oxygen. This the absence of hydrogen in the inferior couches of the atmosphere, being no proof that it does not exist in equal quantity, and in an equally pure state in the superior region of the atmosphere, (though, unfortunately, lying beyond the range of experiment to ascertain,) as what oxygen does in that which lies next the earth's surface.

And as, vertically, the *region of the clouds* in the atmosphere occupies the central space between its opposite extremes; does not this circumstance alone

sufficiently prove the correctness of the assumption that hydrogen exists in the superior region of the atmosphere? As in the formation of rain one half the gaseous matter (hydrogen) that enters into its composition is drawn from its superior, as the remainder (oxygen) from its opposite, or the region next the earth's surface. And as *revolution* is the *conservative* principle of Nature, or that on which the stability of her institutions in the physical world is founded; and that the active agencies of nature, both in *decomposition* and *composition*, by which the principle of revolution is upheld, are electricity and magnetism: how much more conformable is it both to reason and experiment to suppose that in this the fundamental operation by which the renovation of the element of water is effected, no exception to the general rule in other cases takes place. But, as action induces *re-action*, that as by means of the direct or *reflected* action of the sun, electric and magnetic, on the superficies of the earth beneath, the gradual decomposition of its waters into their constituent elements, oxygen and hydrogen, and their sublimation into the atmosphere is, on the one hand, effected; that on the other, in ridding it of their redundance, it is, by means of an opposite action of the electric and magnetic forces in the atmosphere to the preceding, by which their decomposition was effected, that their opposite gaseous elements are collected from its opposite extremes into the central

region, and reunited in the formation of water, which, being thus renovated is returned anew to the earth in rain? This being the assumption of our theory in reference to the formation of rain;* and which by admitting, all the anomalies of the opposite theory disappear; as the various electrical phenomena by which this operation of nature in the atmosphere is attended; or its effect, whether on the barometer or magnetic needle, no longer excite our surprise, they being necessary results of the temporary derangement and partial suspension of the solar action in the region where it occurs; and of

* It has been observed that nothing is so prolific as error: and thus it is that, as the solar action has been hitherto supposed to have its source in *chemical principles*, or combustion; whereas, in reality, it is not the effect of a chemical action in the sun, but of *an electrical action* in the local atmosphere of the earth, induced by the sun. Thus it is that, among the number of false conclusions to which this erroneous view of the subject has led, is that in reference to the elements of water, when sublimated into the atmosphere by the solar action, viz. that they do not undergo a change of condition by decomposition; but that, the same as if rarefied by the action of fire, they remain suspended in the state *of vapour*. But as electric action, as remarked, is one of the universal agencies employed by Nature both in the *decomposition* and *composition* of bodies; thus it is, that the effect in this instance, is totally different from what had been the case if the solar action, which induces the evaporation of the waters of the earth, had its source in chemical and not electrical principles. And thence the origin of the error alluded to, which has so long interfered to retard the progress of correct ideas in this important department of science.

the concentric action of the electric and magnetic forces on these the inflammable elements of water while in the act of undergoing the process of their amalgamation and change of properties. This action, as connected with the renovation of the element of water in the atmosphere, being esteemed decidedly analogous to that in the animal and vegetable kingdom by which the process of their renovation is effected. Nature, in reference to the latter, as assumed, never proceeding but by means of the same principles of action, and which, consequently, is to be considered as in the truest sense *sexual*. And as, in the opposite actions of the sun, electric and magnetic, as connected with the principle of temperature, we have an instance, as stated, of the primary law of *the union of opposite progressions of the same kind*. In these the opposite meteoric actions in the atmosphere connected with its opposite states of *drought* and *humidity*, we are presented with another and a very marked illustration of the application of the same law. These opposite states of the atmosphere, or rather the actions which induce them, being the opposite extremes of the lever, by the alternate action of which on the earth and its atmosphere, the fundamental principle of revolution in both is upheld.

Various facts and arguments might be added to the preceding to show the utter fallacy of the principle assumed by the Rev. W. Whewell in account-

ing for the phenomena of clouds and rain, were it not that I consider them superfluous; which mode of accounting for these phenomena, it may be observed, were better suited to the nursery than the study, or existing march of intelligence on these subjects. Besides, how were it possible to couple this *tea-kettle* principle, with the share which the lunar action is assumed to have in originating rain, or with the influence exercised by the superior and inferior planets on the drought or humidity of the seasons, any more than with the principle of *meteoric progression*, &c.? But the thing speaks for itself, and shows how indispensable it is in treating of natural phenomena, to have, in the first place, obtained by the slow process of persevering application, an elevation such as embraces within the same perspective of contributing causes, the various points of the extensive horizon with which they are more or less intimately or remotely connected. The only thing, indeed, that can be said in justification of the mode adopted by Mr. Whewell and others, in accounting for the phenomena of rain, is that which has been observed in reference to accounting for the phenomena of thunder, &c., on the ancient idea of *chemical effervescence*, and to which may be added the accounting for planetary movement on the principle of *universal gravitation*, viz., "cet antique système prévient en sa faveur par *un air de vérité*, qui entraîne presque tous les suffrages, et parcequ'il

il est très-facile de le concevoir et de l'exposer." However, as observed by the same author, "ce qui est vraisemblable n'est pas toujours vrai; et une opinion quoique consacrée par une longue suite de siecles, n'en est pas pour cela plus respectable, lorsque le flambeau de la vérité vient de dissiper les nuages épais de l'erreur." * But a common symptom, it may be added, and one which of itself may be considered as conclusive of the imperfection of the sciences in which it occurs, is that of mistaking *for primary, secondary causes;* or that which is but *the effect*, for the principle of action itself which originates it; such, as assumed, being the case in the different instances noticed.

Another circumstance, not slightly calculated to perpetuate erroneous impressions in this department of meteorology, is that of the relative difference in the more or less perfect decomposition of water in the atmosphere, which, as is known, is very considerable:—being generally *most perfect* in the lower latitudes during summer, and in the opposite or higher latitudes in winter. This necessarily arises from the more intense force of the electric action of the sun on the temperature in the former, as of its magnetic action on the temperature in the latter regions, than what, in either season occurs, in the intermediate or *central latitudes* of our hemisphere, where, during

* Voyez Bertholon, "*De l'Electricité des Météores.*" T. 1. p. 90.

winter and summer, these the opposite actions of the sun are always less intense; such decomposition being necessarily less perfect in the atmosphere of the latter, in summer and winter, than in the regions on either side; as throughout the hemisphere in spring and autumn. It may be further observed, that the different degrees of the more or less perfect decomposition of water in the volume of the air, is in general correctly expressed by *the different degrees of its transparency*. But though the transparency of the atmosphere, as the various degrees of the more or less perfect decompositions of its air, differs so widely at different times; this does not amount to a proof but that the gradual and progressive decomposition of the element of water beneath, and its sublimation into the atmosphere, in the manner assumed, does take place. As whenever the action of the atmosphere on a piece of damp linen, or other substance exposed to it, is *to dry*, and not to continue or increase such dampness,—humid vapour, *in a palpable state*, cannot be present in its volume: and consequently, the business of decomposition, however slowly, must necessarily be progressing in such a state of the air.

I may add that the phenomena of dew and fog are the *diminutives* of the same species of meteoric action, in which the formation of rain has its source; the principle, (viz. the blending of the opposite, or electric and magnetic actions of the sun in the same

region or couch of the atmosphere,) being the same; and the effects in these cases varying only from the difference which occurs in the amount of such blending, and of the region of the atmosphere where it occurs. The proof of this being the true theory of dew, will be found in the circumstance that the periods of the blending of these the opposite actions of the sun in the inferior region of the atmosphere, in the *diurnal circle*, viz. immediately after *sunset* and *sunrise*, when they occur; are those when the deposition of dew is the most considerable—other circumstances being the same. The periods of these blendings in the *lunar* and *annual circles*, are, as refers to the former, the lunar *octants;* and, in the latter, the *transition seasons*, which, from after the periods of the extreme degrees of heat and cold, in summer and winter, extend thence to the succeeding periods of the equinoxes. And which, other circumstances the same, are decidedly the wettest periods of these circles. But, owing to the peculiar influence exercised by *magnetic action* on the *aqueous condensation* or formation of rain*, at the periods of the lunar syzyges, as connected with the lunar circle; and of the same action, but in a more powerful de-

* The discovery as to the impossibility of the formation of rain in the atmosphere, without the direct co-operation of magnetic action noticed in the introduction, and which will be found fully treated of in the subsequent pages, had not as yet been made when this article was written.

gree, at the periods of the equinoxes,—as will be found more fully treated of in the subsequent pages; combined with that of the increasing force of the magnetic action of the sun on the inferior region of the atmosphere, in the fall of the year, in ridding it of the redundance of its calorific base,—oxygen,—preceding the severe colds of winter; and the influence so frequently exercised on the occurrence of rain by *local causes*;—this the effect of the blending of the opposite actions of the sun in the atmosphere at the periods of the lunar octants is occasionally so merged or deranged, that it were impossible it should, while causes so much more powerful and influential are in operation, be attended by any very distinct or marked effects.

But, however correct the preceding view may be, in reference to the principle in which the formation of rain has its source, and of the place occupied by this phenomenon in the economy of nature, as being the pivot on which the revolution established between the gaseous constituents of water, dispersed throughout the atmosphere, and the parent element beneath turns: considering the importance of the subject as connected with meteorology; as allusion has been made to the experiments reported by Bertholon, in showing its connexion with electricity,—various reasons induce me to insert the following extracts from them; and from the views taken by the the writer in reference to the phenomenon itself, viz.

" Lorsque les nuages sont électrisé *négativement*, et la terre dans un état d'électricité *positive*, les phénomènes doivent être semblable à ceux qui arrivent dans le cas où ils sont doués d'une électricité positive, le globe de la terre étant alors électrisé négativement; puisque l'expérience prouve que les corps électrisés par défaut se repoussent mutuellement, et qu' ils sont attirés par ceux en qui regne l'électricité par excès: ainsi la pluie tombera également du nuage. Cette pluie qui tombe sur la superficie de la terre, peut être appellé avec juste raison *descendante*. Mais, dès que la masse de l'atmosphere est électrisée négativement, la terre étant électrique par condensation ou positivement, les particules aqueuse renfermées dans la terre près de sa surface seront soumises à la vertu électrico-répulsive de la terre et à la force attractive de la masse de l'air atmosphérique, et conséquement s'éléveront dans l'air. Cette pluie très fine, et souvent imperceptible, mérite d'être nommé pluie *ascendante*, comme l'êctricité qui s'échappe de la terre." * *

" Cet effet sera encore le méme dans le cas où la terre chargée de particules aqueuses à sa superficie, seroit électrisée par raréfaction ou par défaut, l'atmosphere ètant dans le même circonstance électrisée positivement. *Les loix de l'équilibre* propre à tous les fluides et particulièrement à celui de l'électricité, exigent cette communication réciproque et alternative entre notre globe et l'atmosphere ;—des

observations aussi multipliées que constantes, nous ont forcé à ne pas méconnoître ce commerce réciproque qui existe entre la terre et les cieux.

"En bonne physique comme en chemie, il faut produire les phénomenes qu'on veut expliquer, en employant seulement les causes assignées; aussi ai-je cherché à m'àssurer par l'expérience de la justesse de l'application des principes exposés précédemment, au sujet dont il est ici question. Au dessous du conducteur de la machine électrique, j'ai suspendu une platine de fer dont tous les bords, et les angles avoient été arrondis; j'avois eu soin auparavant de parsemer la surface inférieure de cette platine de très-petites gouttelettes d'eau. Lorsque la machine électrique fut mise en jeu, *on vit ces gouttellettes s'élancer vers la table* qui représentoit la terre, et donner le jolie spectacle d'une pluie électrique dont la cause etoit la répulsion produite par l'électricité. La force de cette pluie ou la rapidité de la chûte de ces gouttes, étoit d'autant plus grande que la vertu électrique étoit plus forte; et la distance de la plaque de fer à la table étoit aussi relative à l'énergie de l'électricité. Pour représenter la pluie ascendante, ou la rosée, je mets sur le conducteur une plaque métallique semblable à la précédente, mais dont la surface supérieure est arrosée d'un grand nombre de très-petites gouttelettes d'eau. A une distance convenable de cette platine, je place un corps quelconque pardessus, pourvu qu'il soit

conducteur; et lorsqu'on électrise la première plaque on voit sensiblement la pluie s'élever en l'air et donner une image de la pluie ascendante, de la rosée, des brouillards et de l'évaporation de l'eau répandue sur le globe de la terre." * *

" Dans les divers phénomenes de la nature qui dépend de l'électricité, *l'attraction électrique existe en même tems que la répulsion électrique*, et ces deux causes concourent à la production des mêmes effets. On peut donc dire en général que la pluie d'orage sur-tout dépend de l'attraction et de la répulsion électrique, combinées ensemble, ou conspirant au même but. En effet, il n'est personne qui ne voie que, les nuages étant électrisés par excès, et les particules aqueuse de leurs surfaces différentes étant repoussées du nuage, elles sont en même tems attirées par la terre; et que l'attraction et la répulsion électrique conspirent à produire le même effet. *Je suppose ici que l'attraction et la répulsion électriques sont deux propriétés, car il n'est pas improbable que dans la réalité elles n'en constituent qu'une seule:* cette idée est bien dans la nature, qui est aussi simple dans ses moyens que dans sa fin."*

Here we are presented with a series of observations and experiments on, or connected with the

* Voyez Bertholon, " *De l'Electricité des Météores.*" Tome 2, p. 154, et suiv.

phenomenon of rain and its accessories, not on *chemical*, but on *electrical* principles, in which *les traits de famille reciproque*, observable between them, are so striking, that they are not to be mistaken; and which of itself is demonstrative of the justness of their relations and mutual connexion. By them, on the principle of electrical *attraction* and *repulsion*, we are shown, by reason of the opposite states of electricity subsisting between the earth and its atmosphere, shortly before and after thunder-storms, and of the changes in the relations which take place at these periods between them, why the meteoric effects are so opposite, viz. in the first instance, or when, by reason of the formation of the thunder cloud, the atmosphere is *positively* electric, while the earth beneath is in an opposite state, or *negatively* electric, the principle of electric attraction exercised by the earth on such cloud, induces the rapid and heavy descent of its contents, whether it be hail or rain, thence denominated by Bertholon *pluie descendante*, or descending rain; while, immediately after the fall of such rain, owing to its having carried with it, from its parent cloud, the redundance of its electricity, and, together with itself impregnated with it the surface strata of the earth, and thence reversed the scale of electric action between the earth and atmosphere; thus, from the principle of electric attraction being transferred to the atmosphere, causing that such rains are succeeded by co-

plous exhalations from the earth, thence denominated by him *pluie ascendante*. The principle in each case being proved by the opposite effects produced by the discharges of an electrical battery, reciprocally on the opposite sides of a metallic plate, charged on the reverse with a slight sprinkling of minute drops of water, which thence are made to descend as rain, or ascend as evaporation, according to the side of the plate on which the electrical current is brought to act. Thus far, it may be observed, experiment and fact go hand in hand; and, together with the principle of the heavy discharge of rain from a thunder-cloud, we have likewise that—perhaps the only true one, variously modified—of the hurricanes and storms by which such rains are occasionally attended, viz. in great part by these the opposite electrical states of the earth and atmosphere, *vertically*, at such periods, as between proximate regions of the atmosphere, *horizontally*, that of the true theory of the winds. But of this, more in a subsequent article.

This material difference, however, occurs between these and such like experiments, and the meteors they are intended to represent, viz. that in the experiment, the water intended to represent rain *is already formed;* and the apparatus employed presents no more than an *electrical* agency; whereas, in the meteor, the rain is called into being, or *generated* from its gaseous or aëriform elements; and electric action, instead of being, as in the experiment, in its

simple or detached state, is always in combination with *magnetism;* considering the earth and its atmosphere as a *thermo-electrical combination*—and which, consequently, to judge by such experiments, or deduce conclusions from them, were about the same as to judge of a countenance by its profile. As these experiments, however imperfectly, notwithstanding, sufficiently prove the connexion of electricity with these meteors, and that the law is known by which electrical and magnetic currents are governed, when, as in the atmosphere, combined, viz. that they traverse or cross each other at right angles: the application of this law may probably be used with effect, in explaining some of the most important phenomena of the atmosphere; for, assuming *magnetic action* to be, in all cases, combined with electric, in the formation of rain, and its accessory phenomena; if the *axis* of the meteor in the middle region in which the latter, or formation of rain, had its source, were *vertical*, the currents it induced, according to this law, should be *rotary*. And as, particularly at the equinoxes, and during winter, the most violent tempests usually commence in a particular region of the atmosphere, and thence gradually advance to an opposite, if this the axes of *horizontal progression* of such meteors were, suppose, from south to north, the currents they created, as being at right angles with such axes, should be *east* or *west*, and *vice versâ*. But, as the region

in which storm and rain originate is more or less elevated, according to the latitude and season, and thence, on the principle of re-action, that when a current is induced in the inferior region by the meteor in which these phenomena have their source, an opposite current will, of necessity, be originated immediately above it, or in the superior region of the atmosphere. On these principles, we are enabled, in the first place, to account for the opposition of the currents in the superior and inferior regions of the atmosphere, so frequently noticed; their source, as that of the opposition noticed in their direction, being in the meteoric action progressing at the time in the central region by which they are separated; and, in the second place, why it is that storms take a direction at right angles with the axes of their progression. An instance of the latter will be found noticed in the "*Weather-Guide Book*," published by me in 1834, page 256, in the gale which commenced on the Irish coast on the 11th of June, 1833, and which thence passed over Black Pool, on the coast of Lancashire, on the following day, where it caused the wreck of ten ships, and finally reached London and its vicinity on the 14th, where, the mischief it occasioned, as stated in the papers, was incalculable. The axis of progression of this meteor being from *north west* to *south east*, while the direction of the hurricane it induced was from the *south west* to *north east*; being, as there noticed,

(though, from its not being apprehended at the time; no allusion is made to the principle,) nearly *at right angles* with its axis of progression. And, as the facts in these cases are in accordance, at once, with theory and experiment, they seem to place, beyond doubt, the correctness of the principles assumed.

It is hardly necessary to add, that, in reference to the first case assumed, or when the axes of these meteors *are vertical,* we are presented with the principle or cause (the only true one, as far as I am aware of, hitherto proposed,) in which the *trombe,* or water-spout, the whirlwind, and this class of phenomena, has its source. For, as the movement of rotation round their axes, in the middle or superior region of the atmosphere at their commencement, increases in its dimensions with their increase, and extends progressively in the direction of the earth, in the form of an inverted cone—as soon as it has reached the latter, simply by the force of the *suction* it induces, both water and other substances that come within its vortex, are, proportioned to its force, elevated into the air in the direction of its focus; from which they are subsequently projected *in an opposite direction* to that of its progression. And, as in the latter case, and thunder-cloud, equally as in the experiment of the helix, we have an instance of the effects induced by the electric and magnetic forces, when collected on, and revolving round a local

centre or axis; I may add, that in this the concentric action of these forces in the atmosphere, equally as in the case of the larger class of *globular meteors*, or those from whose bosoms meteoric stones are occasionally projected—we have so many instances of their action, as in the earth and remainder of the planets, giving birth to and producing, in these respective meteors, *a force of gravitation:* for, it is owing to this circumstance, and to the direction of this new force of gravitation being, *on one side*, directly opposed to this action in the earth immediately beneath, as being a homogeneous action, and only in consequence thereof, that the measure of terrestrial gravity, on the volume of the atmosphere, could be affected; so that, in this circumstance, we have explained to us not only the principle of the vortex, or attractive action exercised by such meteors on the proximate regions of the atmosphere, but the true cause of the fall of the mercury in the tube of the barometer, which they occasion;—the latter keeping exact pace in its amount with that of the force of concentration or gravity, at the time, acting on their axes. For, to suppose that the specific gravity of the atmosphere could be affected by any other than by the intervention of a similar principle to that in which it has its source, were the same as to suppose that the weight of a body suspended on one side of a steel-yard could be affected, except by means of the action, more or less consi-

derable, of a similar or other body suspended on the opposite: as in each case the intrinsic specific gravity of the body itself is still the same, and is only altered by reason of a similar action being opposed to, at the time, and coming into collision with it. And (as is the case of the summits or higher regions of mountains,) any circumstance which varies or disturbs the equilibrium of the action of gravitation on the atmosphere, has the effect of disposing it, more or less, to the species of meteoric action in which rain has its source, and *vice versâ*. Thus if, for instance, a comet happened to approach so near to the earth, as that, similar to the larger class of meteors, the local concentric action of the electric and magnetic forces on it, had the effect of disturbing the equilibrium of its gravitation in the atmosphere. It is easy to see that, on the principle noticed, the seasons of the approach of such bodies would be more or less remarkable for rain; and, on the contrary, that when comets ranged at such a distance as that, without affecting the local action of gravity on the atmosphere, by increasing the sum of reflective action, they rather added thereto; the contrary, or increased drought in the seasons would be the result.

CHAP. IX.

Application of Principles:—Climate, in Reference to the Geographical Distribution of Animals and Plants.

Be this however, as it may, as in treating of the assumed connexion of planetary influence with the changes of the seasons, we shall have to resume, on different grounds, the subject of comets: having thus touched in detail on the leading phenomena connected with the earth and its atmosphere; and guided at once by observation and experiment, traced them, as assumed, to their respective causes, or first principles: we shall now proceed with the no less important task of showing the application which may be made of these principles to some of the various objects of utility with which they are connected.

These objects may be classed under the following general heads, viz. as connected with *climate*, in reference to the geographical distribution of animals and plants; with minearology; with earthquakes, and volcanic action; with *localities*, in reference to their assumed influence on the temperature and weather; with planetary and cometary influence on the seasons; and finally, as connected with the equi-

noctial phenomena, and the lunar action on the weather.

And first as regards climate:—were the principle of temperature in the atmosphere, derived from the opposite actions, electrical and magnetic, of the sun; the whole of the dispositions and mechanism of nature in the earth and remainder of the planets, whether local or external, as connected with the temperature, the variations in the animal and vegetable kingdoms connected with those of climate, or the phenomena of the seasons and weather, would be found in accordance therewith; so that, deprived of all other, the facts connected with the latter would, of themselves, serve as the most certain and conclusive proofs, in reference to the correctness of the principles assumed.

In proof of this, as connected with that most important subject, *the geographical distribution of animals and plants*:—owing to the circumstance that the *magnetic*, equally as the *electric* action of the sun, is one of the principles which enters into and determines the peculiar nature of *climate* as connected with the constitution of animals and plants; and that the positions of the opposite main foci of the magnetic action of the sun in either hemisphere, or magnetic poles, are equally fixed and invariable, as the position occupied by that of its electric action at the Line. This causes that as great a difference in reference to the meteoric

conditions which determine the nature of *climate*, exists along the varying *scale of longitude* in either hemisphere,—however imperceptible in the temperature,—as *on that of latitude*. And hence, as assumed, the source of the mystery which has so long involved the subject of climate, and which has baffled all the attempts hitherto made to ascertain its cause; as shown by the failure which, as in the case of the tea-plant, and others, has so frequently attended the attempts that have been made to introduce some of the products of certain countries, where, from the climate being considered the same, or better, it was supposed they would succeed equally well as in those of their nativity: this being a necessary consequence of the ignorance of principles. But as with the exception of the difference that occurs in *the nature of the magnetic action of the sun* on the opposite hemispheres of the earth, the same conditions of climate exist equally in both; but that from the difference in the sites of their magnetic poles, these conditions are, in regard to their positions, necessarily reversed to each other. Thus it is that, however diversified, and different in their positions, a common identity or sameness of climates exist in the opposite hemispheres; in this, that there is no climate in either,—as regards the circumstance of meteoric conditions; but that a similar climate may be found in the opposite.

And consequently there is no product of the animal or vegetable kingdom, however delicate, in either hemisphere, for which a suitable climate is not to be found in the opposite, equally adapted to its introduction as that where it was originally found and of which it is a native.

Thus as, according to the principle assumed, the chief source of error hitherto, in reference to climate, consisted in not having taken into account the circumstance of *longitude*,—(or difference of magnetic action,) equally as of latitude, (or the difference of electric action,)—though a glance at the difference which exists between the products of the animal and vegetable kingdoms of the opposite extremes of the scale of longitude, within the same parallels of either hemisphere, as between those of latitude;—will immediately show, assuming it to be the cause, the extent of the influence on both, exercised by the former, equally as by the latter action of the sun. As connected with this subject, the following observation from the preface of an agricultural work, published in Dublin, 1764, by Mr. H. Rowlands, may be considered, from its novelty, as not a little curious; being, indeed, the only one bearing on the assumed connexion of magnetism with the constitution of plants, that I have met with, viz. "And probably it may also be a means to discover the proper subject of *that noted magnetism*, which is observed to lie in the substance of the mold, attracting into it in great

proportions the *analogous salts* and *sulphurs* of the air, of which the Italian virtuosos in their country have discovered very notable instances."

Assuming then, that magnetic action is equally operaticve and influential as electric, on the constitution of animals and plants;—and that as great a variety occurs in the nature of magnetic action on the varying scale of longitude in either hemisphere, as on that of latitude; and at the same time that an equalisation of climates, as stated, exists between the opposite hemispheres. Without entering further into the subject in this place, I shall confine myself to pointing out *a rule* by which the same meteoric equivalents in either hemisphere, as refers to climate, may be found in the opposite, other circumstances being the same, viz.—Having ascrtained the latitude and longitude of the place in either hemisphere, where, in the opposite, a similar climate is sought to be found:—by referring to the same degree of latitude, and adding to the degree of longitude if—suppose *west* from Greenwich —the number which, combined with it, makes the sum of 180°;—such additional number, *east longitude*, in the opposite hemisphere, will be the site of the climate required: and *vice versâ*, as refers to *east* and *west*, on the contrasted scales of their longitude.

By the application of this simple rule, as assumed an obstacle hitherto insurmountable may at

once be got rid of; and thereby an interchange of some of the most valuable products of either hemisphere be made with the opposite; and by means of such reciprocal exchanges of the local advantages possessed by either with the other,—thus, at once, increasing their amount, and the range of their usefulness. And notwithstanding that, in the absence of *trial*, in a matter such as this, it cannot be expected that much in the way of proof can be referred to, in illustration of the principle assumed. By contrasting the site of what is called the *tea-country* of China and Japan in the northern, with that of *Paraguay* in the southern hemisphere, where, only, in that part of the world a species of the tea-plant is found indigenous, viz. the celebrated *Matte*, or as the Spaniards denominate it *Yerba de Camini*;—it will at once be seen what a close approach to an identity of climate, on the principles assumed, exists between these countries. And that this influence of climate is not confined to the vegetable kingdom, the success which has attended the introduction of the *merinos* into New South Wales may be considered as affording a proof no less in point, or striking, than the instance cited. For, in examining the conditions of climate subsisting between the southern provinces of Spain, in the one, and the vicinity of Sidney in the other hemisphere, they will be found equally proximate as in the case of their tea-countries. Thus shewing what

an extensive field of tempting speculation is opened to the inhabitants of that rising colony, to introduce and domesticate the Spanish vine and olive in their fields, equally as the merinos. For if, as there is some reason to suppose, a similar *improvement* of quality in the produce of these plants attended their introduction into Australia, as occurred in the case of the *Merino wool:* instead of having any thing to apprehend on the score of failure, an improvement in each case might be anticipated; as though it were a *bounty* held out by nature to such as, in this way, extend the empire of her most useful gifts.*

CHAP. X.

Climate as connected with the Mineral Kingdom.

In reference to the connexion of climate with the mineral kingdom, though it is necessarily much more questionable than in the case of animals and plants; yet, as it has been touched on by others, I

* I may notice, *en passant,* that a paper on this interesting subject was forwarded by me in the summer of 1834 to the then colonial secretary, which contained much that, I considered, might prove of importance to the interests of our colonies:—but I have not learned whether or not any particular attention has been paid to it.

should consider it remiss not to notice the subject in this place. For, it may be recollected, that St. Pierre, in the affluence of his imaginings, considered that a very marked connexion is apparent between the sites of *gold mines* and the summits of the higher ranges of mountains, but more particularly those which are permanently covered with snow. And be it remembered that, though, as relates to principles, this supposition may be worth nothing; it is that of a man who, notwithstanding the errors (and they are not few,) which he has fallen into, has produced a work *on Nature,* which promises to be no less durable than its subject,—" Je remarquerai ici, au sujet des mines d'or," he observes, " qu'elles sont placées, ainsi que celles de tous les métaux, non-seulement dans les parties les plus élevées des continens, mais dans *des montagnes à glace.* Les fameuses mines d'or du Pérou et du Chily sont, comme on sait, dans les Cordelières; les mines d'or du Mexique sont situées aux environs de la montagne de Sainte-Marthe, qui est couverte de neige toute l'année. Les fleuves de l'Europe qui roulent de l'or sur leur rivages, sortent des montagnes à glace." * " Cette observation peut s'étendre, comme je le crois, a toutes les mines d'or du monde, même à celles de l'Afrique dont les rivières qui charient le plus de poudre d'or, comme le Sénégal, descendent des montagnes de la lune." * " Quoiqu' il en soit, on peut presumer de ce que les mines

d'or sont placées dans les lieux les plus elevés du continent, que leurs matrices, recueillent dans l'atmosphère les parties volatilisées de l'or, qui s'y élèvent avec les emanations fossiles et aquatiques que les vents y apportent de toutes parts."—*Etudes de la Nature,* Tom. 2, p. 292, et suiv. Such are the ideas of St. Pierre alluded to. And even admitting the insufficiency of the *attractive principle* to account for the circumstance noticed; this coincidence between the sites of the generality of gold mines and the summits of mountains, or the most elevated points of the earth's superficies, is, to say the least of it, not a little curious and remarkable. And as the brilliant discoveries of Sir H. Davy show that through the medium of electric action, the earths are resolvable to *metallic bases*; and further, that, as refers to this general law, even the air *we breathe*, proves no exception, as shown by the *aërolite*; but that when acted on by the electric spark in the larger class of meteors, its impalpable volume resolves into an earthy and *metallic base.* If in addition we assume, as I hold to be the case, that the whole of the active forces of nature in the physical world, whether as connected with the opposite processes of *composition*, or *decomposition*, are either immediately referable to, or derived from electric and magnetic action; and that, from the substances which compose the solid crust of the earth, equally as its waters, belonging to the class

of what are called *conductors*, they are alike permeable to the action of the electric and magnetic forces, though differently, as the superincumbent atmosphere itself.

And thus, assuming that these the universal agents of Nature admit neither of suspension in their action, or of restraint, but that the march of their activity is equally interminable on the one hand, as boundless in its range on the other; that they always act in *conjunction*, notwithstanding that in the relative degrees of their united agency, as connected with the various regions of the earth and its atmosphere, they are modified *ad infinitum*. If, considered under this point of view, that a connexion were found generally to subsist between *climate* and the sites of the chief mineral districts of the opposite hemispheres, according to the principles assumed; instead of detracting from the value of the assumption of St. Pierre, as to the supposed influence of climate on the formation of metals, &c. it would, on the contrary, rather add weight thereto. And by contrasting, as in the instance of the tea-plant, the mines of Hindostan, China, and Japan, with those of Mexico, Peru, and the Brazils, as connected with the opposite hemispheres, whether in reference to the precious metals, gems, &c.; the same striking coincidence in this respect will be found to subsist between them, as in the former case. *Borax* may likewise be noticed in the way of

illustration, as perhaps of all fossil substances, if we except the *diamond*;* it is that which shows the most marked connexion, in this respect, with climate. This substance, as is known, being almost exclusively confined to Tibet in the northern, and to the neighbourhood of Potosi in the southern hemisphere; and consequently, the coincidence it presents, is still more marked than in the preceding instances. But even though the assumed connexion between the mineral kingdom and climate really existed, it could only be considered as curious in a scientific point of view; as the deductions to be drawn from it are so general and vague, that it is not likely they can ever lead to any thing really practical or useful.

"L'origine des méteaux," observes *Raynal*, "n'a pas été toujours bien connue. On a cru long-tems qu'ils étoient aussi anciens que le monde. On pensé aujourd'hui, avec plus de raison, *qu'ils se forment successivement*. Il n'est pas possible en effect de douter que la nature ne soit dans une action continuelle, et que ses reports ne soient aussi agissans *sous nos pieds* que sur notre tête."—*Histoire Philosophique*. Tome sixième, page 51.

* By contrasting the geographical position of Solempour, the chief diamond mine of Hindostan, with that of Caravelas, and Terro de Frio, in Brazil, under this point of view, the coincidence will appear not a little remarkable.

CHAP. XI.

Climate, as connected with Earthquakes, and Volcanic Action.

In reference to the destructive phenomena of earthquakes and volcanic eruptions, were it not that I consider them, however remotely, as being connected with meteoric action, I should not notice them in this place; and as, in our inquiry, it will be necessary to recur a little to first principles, from the circumstance that opinions are divided in regard to their source, I shall commence with the following, as it appears to be the most generally accredited account of them, taken from Dr. Ure's Dictionary of Chemistry, article *volcanoes*:—"The combustion of those enormous masses of bitumen, which are deposited in the bowels of the earth, produces volcanoes. They owe their origin more especially to the strata of pyritous coal. The decomposition or action of water upon the pyrites, determines the heat, and the production of a great quantity of hydrogen, which exerts itself against the surrounding obstacles and at length breaks them. This effect appears to be the chief cause of earthquakes; but when the concourse of air facilitates the combustion of the bitumen and the hydrogen, the flame is seen to issue

out of the chimneys or vents which are made; and this occasions the fire of volcanoes." Again, "When the decomposition of the pyrites is advanced, and the vapours and elastic fluids can no longer be contained in the bowels of the earth, the ground is shaken, and exhibits the phenomenon of earthquakes. Mephitic vapours are multiplied on the surface of the ground, and dreadful hollow noises are heard, &c." Thus, it will be seen, the doctor very naturally accounts for these phenomena on *chemical principles;* and it must be allowed, if we were *to judge from appearances,* that such were really those in which they have their source. But, as has been ingeniously observed by Fontanelle, " En physique, dès-qu'une chose peut-être de *deux façons*, elle est ordinairement de celle qui est *la plus contraire aux apparences.* Il est possible que la terre tourne autour du soleil, ou le soleil autour de la terre, et *c'est ce dernier, que paroît aux yeux de tout le monde, ce sera donc le premier qui sera le vrai*, &c." And thus, notwithstanding appearances, probably it is, in reference to the source of earthquakes and volcanoes; for, similar to the commonly accredited theory of solar light and heat being derived from the principle of combustion in the sun—one of the most conclusive arguments that can be opposed to it, appears to be derived from the circumstance that, without the operation of a *different cause* in the phenomena of volcanoes and earthquakes, than the

chemical one of *fermentation*, it were impossible that the bowels of the earth could have supplied, through such a countless succession of ages as the past, fresh pabulum or *combustible matter* to be acted on; and still, notwithstanding, as in the case of the solar light and heat alluded to, without any sensible diminution or falling off having taken place in the mean amount of these phenomena. Besides, as is known, it is of the nature of combustion, when it sets in, that if it be not arrested in its course and extinguished, it continues to consume all the combustible matter that comes within its reach, and that it only ceases when it has no longer such matter to act on; and, consequently that, under this point of view, as chemical combustion (which, it may be observed, cannot exist in the absence of air, any more than hydrogen gas in an elastic state, when it comes into collision with water,) only ceases from exhaustion, or when it no longer has matter to act on; and thence, necessarily, leaves in the locality it has once visited, no further pabulum to minister anew to the same species of action.

How were it possible, on these principles, to account for a renewal of the same phenomena, after stated intervals of time in particular localities, such as Vesuvius, Etna, and other volcanoes, which, from the earliest records of time, have continued in activity, without any apparent falling off in the frequency or force of their eruptions being perceptible? And,

on the other hand, as regards earthquakes, had they their source, as supposed, in the principle of *explosion*, the effect would, as in the case of mines, be both local and *simultaneous;* whereas, the contrary occurs in earthquakes, which, as not unfrequently happens, continue during several days, weeks, and even months at a time, similar to that which commenced in Calabria on the 5th February, 1783, and continued its destructive effects both there and throughout Sicily during the five following months. It is further characteristic of earthquakes, that they in general commence at a particular point, and thence extend to distances more or less considerable, similar to that of the 1st November, 1755, by which the city of Lisbon was destroyed, and which, as is known, extended to different parts of Europe and Africa; and that of the 13th October, 1694, by which the town of Catania, in Sicily, was destroyed, and which, we are told, was felt even at Lima, on the opposite side of the earth! Another circumstance connected with earthquakes is likewise worthy of notice, viz. that certain places in the line of their progression remain *unaffected,* while those on either side are convulsed by their action; thus proving, as observed by M. Gueneau de Montbeillard, that "ce n'est point par la communication des terreins contigus que se propagent les tremblemens, puisque *des pays intermédiaires* quelquefois plus élevés,

quelquefois plus bas *ne sont point ébranlés.*"* Besides, if volcanic eruptions were effects simply of combustion, induced by fermentation in the bowels of the earth, how were it possible they should be accompanied by those *zigzag flashes of lightning* which are so evidently of electric origin? and which, as will be seen in Mr. Hamilton's account of the famous eruption of Vesuvius, which happened in August, 1779, published in the *Philosophical Transactions*, form so conspicuous a feature in these phenomena; indeed, it is only by assuming, with Bertholon, that earthquakes and volcanic eruptions are effects of *electrical agency*, and result *from the recovery of the equilibrium of electric action between the earth and its atmosphere when disturbed*, that such insurmountable difficulties as these noticed, and which are not to be explained on chemical principles, can be accounted for. As, in admitting electricity to be the *moteur* in these, as in the other grand phenomena of nature, the difficulties connected with the opposite theory immediately disappear, from the circumstance, that in it we have an agent, in all respects adequate to the production of these the tremendous effects by which they are attended.

It has been already observed, and cannot be too frequently repeated, that of all the errors fallen

* Journal Encyclopédique, 1769, Déc. 1, pag. 459.

into by philosophers, in their attempts to account for natural phenomena, the most general, and injurious to the interests of science, has been that of mistaking *secondary* for *first causes*. For, as if a necessary result of our ignorance of first principles, in examining the original ideas and opinions that have been advanced in reference to the assumed sources of natural phenomena, hardly an exception occurs in this, that what has proved to be no more than *an effect*, has, in the first place, been set down as *the cause itself*. Thus, as assumed, it is, in regard to the principles of *heat* and *cold* in the atmosphere, and of *gravitation*, and to which, in the present instance, the principle of *fermentation*, in regard to the source of earthquakes and volcanic eruptions, may be added. And as, in reference to *electrical*, as contrasted with *chemical principles*, our acquaintance with the latter preceded our acquaintance with the former, is it to be wondered at that, as in other cases, and being, as they are, most assuredly, the *most obvious*, they should have been the first referred to, in accounting for these phenomena? But, in reference to electrical, as contrasted with chemical principles, it is to be observed, that together with the latter being occasionally derived from the former, electric action has this peculiar to itself, that it is not only infinitely more efficacious and powerful, as an agent, than chemical action, but that its effects, however considerable, are brought

about almost instantaneously. I may add, in reference to this mysterious agency, that, as from the period of our first acquaintance with electricity, the sphere of its activity in nature has been found constantly more enlarged than was previously supposed; that it has kept pace, in its increase, with that of our increased acquaintance with it; till at length, numerous concurrent circumstances lead us to conclude that the limits of its activity are only circumscribed by those of nature itself. And as, being a consequence, that, in proportion as assumptions have been hazarded in regard to this the increased range of electrical agency, experience has continually proved, *that we were, in the same proportion, right.*

Thus, to resume the subject of volcanoes. As it is supposed there are no less than seventy-six of them still in activity, of which four are in Europe; twenty-four in Asia; three in Africa and the neighbouring islands; forty in America; and five in the islands of the Pacific Ocean;—how were it possible, without the presence of an agent such as electric action, to whose touch, as is known, the hardest of terrestrial substances is but *as wax*, for a quantity of pabulum, such as these consume and eject, to be supplied to the same sources through such a series of ages, and yet without suffering any sensible diminution in its amount? Indeed, as Nature, under similar circumstances, is always found to be analogous, in order to understand the true theory of vol-

canoes, it were, probably, right to refer to the manner in which (assuming them to be united,) the primary electrical and magnetic forces act in the larger class of globular meteors: for, though these bodies originate in the local atmosphere of the earth, they do not, in my opinion, though in miniature, the less truly represent the manner in which these forces act, as refers to *internal combustion* in the sun and planets. For, as when the equilibrium of electric action in globular meteors is destroyed, by the repulsive force from within overcoming the attractive force on their superficies from without, *explosion ensues*, in which the *lava* they engender is projected to the earth in the shape of meteoric stones. Thus, as assumed, it is in the case of volcanoes, whose throes, as we are told, have been known occasionally to shake the entire globe of the earth—that when the equilibrium of electric, or rather of *meteoric* action between the earth and its atmosphere in any of its regions is disturbed, that it vents itself either in earthquakes or in volcanic eruptions, till restored. And were our assumption correct in regard to meteors, and that comets belonged to this class of bodies, it would lead to the conclusion that *the whole of the heavenly bodies had their source in the same species of action*, which would account for the formation and extent of the *granit strata*, so generally diffused over the entire superficies of the earth, being as they are *a species of lava*, and, con-

sequently, derived from a similar source of action as the latter. And, as the axes of the orbits of the planets pass through the centre of the sun, and are assumed to be that of his rotation, or rather of his magnetic poles. As further illustrative of the correctness of our assumption in reference to the analogy supposed to exist between the globular class of meteors and the planets, as evinced by their possessing (as far as we are enabled to judge of,) the same polarities as the latter bodies, that if this were the case, their *direction* in traversing the atmosphere should correspond with that taken by the planets in their orbital courses in reference to the sun, i. e. that the direction of such meteors should be the same as that of the *magnetic meridian*. By a reference to facts, we shall find that this is really the case, as, notwithstanding their *inherent* principle of movement, which would seem to render them independent of the magnetic attraction of the poles of the earth, the progression of the generality, if not the entire of the globular meteors, has been observed to be along the magnetic meridian, or from N. W. to S. E. Such was the direction of the famous meteor of the 17th July, 1771, as observed both from France and England: "son movement," in the words of the celebrated Lalande, "se fit *du nordouest au sud-est*, ou plus, approchant cependant de la direction nord et sud." Such was the direction of that which appeared in England on the

night of the 18th August, 1783, in passing over London, which, as the preceding came from the N. W. and passed on to the south-east,* being thus so far corroborative of the principle in which, according to our theory, the elliptical movement of the planets has its source.

But to resume the subject of volcanoes. As it was not my intention, in introducing it, to notice more than its assumed connexion with meteoric action, I would beg to direct the attention of those who are curious on the subject, to the work of M. Bertholon, already cited, where they will find, perhaps, the most complete digest of all that history has transmitted to us of the most memorable eruptions and earthquakes that is to be met with. But, assuming the connexion of these phenomena with meteoric action, and that the principle on which it depends, as stated, consists in the preservation or derangement of the equilibrium of electric action between the earth and its atmosphere. As, in the list of natural causes which might be supposed the most capable of preserving this equilibrium, the equal succession of drought and rain after short intervals of time, were that which should the most perfectly establish and uphold it; as the absence of such a succession of changes in the weather were, on

* *Bertholon*, "De L'Electricité des Météores." Tome Second, pag. 18, &c.

the contrary, that which should the most naturally disturb and overthrow it. And further, that as in most of the subjects connected with meteoric action, similar to climate, the lunar action on the weather, &c. it is only by grappling with *ensembles*, that correct ideas are to be arrived at or obtained. By comparing the positions of the great majority of the volcanoes of the opposite hemispheres of the earth, equally as their number, though, in reference to the latter, the greater part are situated in the southern hemisphere; yet they will be found *to be connected with the same axis of meteoric action in both*, viz. *that which is reversed to the axis of their magnetic poles;* and thus that they are situated in the same direction in these hemispheres as that of their great *mineral districts*. And which circumstance of the axis of meteoric action, as connected with these the opposite hemispheres, being thus reversed to that of their magnetic poles, (as I hope to show, in treating of climate,) exercises a very material influence in disturbing the equilibrium of electric action between the earth and its atmosphere. For, to come to particulars, did the upholding or loss of the equilibrium of electric or meteoric action, between the earth and its atmosphere, depend on the principle assumed, viz. that of the regular succession of changes in the weather, from drought to rain, as from rain to drought; or the interruption and suspension of this succession of changes in the weather. As the coun-

tries of the middle latitudes, and more particularly such of the latter as possessed (similar to Ireland,) the most temperate and humid skies, were those where the phenomena of earthquakes and volcanoes should be the least frequent; and, on the contrary, that the countries of the lower latitudes, owing to the absence of rain, were those where this equilibrium were the most frequently disturbed, and, consequently, should be those the most subject to both; and that, were there in the latter any region where, owing to the influence of local causes, less rain occurred throughout the year than elsewhere; such, according to the principle assumed, should be that which was the most remarkable for earthquakes and volcanic action. And accordingly, by testing the principle with facts, we shall find it so fully borne out, that, did the decision of the question depend on this, it must be considered as triumphantly established and proved. For, as Ireland may be considered to occupy the extreme of the scale, in reference to the equal succession or blending of the opposite species of meteoric action in its skies, connected with drought and humidity, and where the equilibrium of electric action between the earth and its atmosphere, depending on this succession, were the least frequently disturbed; and, on the contrary, that the vicinity of Lima, and remainder of the seaboard of Peru and Chili, in part of which, as is known, the absence of rain is continual; may justly

be placed at the opposite extreme point of this meteoric scale; and consequently, where such equilibrium between the earth and its atmosphere were the most frequently disturbed; and that, as the former country were that which was the least liable to earthquakes, the latter countries should be those which were the most subject to them. By contrasting the annals of these countries in regard to visitations of this kind, it will immediately be seen that they are not more strongly contrasted in the weather of their seasons, than what they are in the difference which exists between them in regard to the occurrence of earthquakes—no country, perhaps, being less subject to them than Ireland; or more so than Peru and Chili. On the same principle, it would follow, that seasons which have been remarkable for great drought, were those that proved the most remarkable for earthquakes and volcanic eruptions. And, accordingly, notwithstanding the little attention which, in the absence of suspecting the existence of such a connexion, was formerly paid to that most important circumstance in inquiries of this kind, viz. the species of synchronism that has existed between the seasons and weather at the time, and the occurrence of the most remarkable earthquakes, or volcanic eruptions. Together with the instance alluded to of the coincidence between the extreme drought of the climate of Peru, and the greater frequency of earthquakes there than in, perhaps, any

other region of the globe. In the list of causes assigned by philosophers at the time, to account for the extraordinary fog or obscurity in the superior region of the atmosphere, which, on the 18th of June, 1783, first made its appearance, simultaneously, throughout the greater part of Europe,—nearly eclipsing the light of the sun—and which continued, without interruption, during several months, being, as it was, co-existent with the earthquakes in Sicily and Calabria, of this year, already noticed. I find the following, assigned by M. Castelli, an Italian physician, as cited by Bertholon, in the second volume of his meteorological work, page 141, viz. "M. Castelli, tire l'origine des météores extraordinaires de 1783, *premièrement du défaut de pluie qui a eu lieu pendant plusieurs mois avant leur apparition;*" and to the loss of the equilibrium of electric action between the earth and atmosphere, consequent thereon; being thus, as will be seen, exactly conformable to what, on the principle assumed, might be expected to have been the case.

However, as extremes approximate, it will excite no surprise if excessive rains should, similar to excessive drought, destroy the equilibrium of electric action between the earth and its atmosphere, and thus to have been occasionally known to be the precursors of earthquakes. The earthquake which occurred at Florence, in 1449, was thus, as we are informed, preceded by continual rains; and seven

years afterwards, on the 5th of December, an earthquake, which destroyed several towns in the kingdom of Naples, was similarly preceded by incessant rains, unaccompanied by wind, during two months. It however, frequently occurs, that the same species of electric action in which earthquakes are assumed to have their source, is co-existent with them in the superincumbent atmosphere, at the time of their occurrence, as though these opposite actions were the counterparts one of the other; and that thus an immediate connexion appeared to exist between "*les tonneres céleste et terrestre*," as they are denominated by M. Paulian. Such, amongst a number of others, was that by which Naples was visited in 1343, and of which the following appalling picture has been left us by the celebrated Petrach, who happened to be at Naples when it occurred, viz. "Il seroit impossible de peindre l'horreur de cette nuit, où tous les élémens paroissoient déchaînés. Rien ne peut représenter le fracas épouvantable que faisoient le vent, le tonnerre, et la pluie mêlés ensemble, les mugissemens de la mer en fureur, les mouvemens intérieurs de la terre ébranlée,"* &c.

Having thus, as I assume, with Bertholon, (that worthy associate of a Franklin and the other eminent men of his time, who, aware of its importance, distinguished themselves in the wide and interesting

* Bertholon, *De l'Electricité des Météores*. Tom. Prem. pag. 372.

field of meteoric inquiry,) shown, that an intimate connexion subsists between meteoric action and the phenomena of earthquakes; and that, as to their source, the immediate cause of earthquakes is to be traced to the loss of the equilibrium of meteoric action between the earth and its atmosphere, as being the sole principle in nature adequate to the production of such effects. And further, that in this principle we may likewise perceive the source of those revolutions by which the substances connected with the depths of the ocean have been transferred to the summits of the Alps, and other such mountains.* But that, as the period of these extraordinary changes in the superficies of the earth appears to be long since passed by, owing, probably, to the more perfect separation of its elements of earth and water, than what, in its early stages, existed, brought about by the gradual operation of time; and that a *remedy* which, though formerly tried and found to be effectual, appears to be entirely lost sight of, might

* As being, in some sort, demonstrative that mountains have had their source in volcanic action, it is to be observed, (and will probably be esteemed as not a little curious,) that the highest mountains of the globe are, in their position, connected with the opposite *poles of volcanic action* in the opposite hemispheres, (as will presently appear,) viz. the mountains of Tibet, in the northern, and Chimborazo, and its neighbouring Andes, in the southern hemisphere; and which, as if to counterpoise each other's weight, have thus been placed nearly equi-distant on the opposite sides of these hemispheres.

still be applied, and prove the means of arresting the ravages in certain countries, such as Peru, so frequently induced by earthquakes; I shall conclude the present notice of them with pointing out this remedy, under the idea, however illusive, that it may be productive of good.

M. Bertholon, at the conclusion of his interesting dissertation on volcanoes and earthquakes, in the work of his alluded to, in which he treats them as electrical phenomena; and as being a necessary consequence of the success which attended the idea of placing lightning conductors on buildings, to protect them from the effects of thunder; having fallen into the opinion, that vertical iron bars, deeply inserted in the surface strata of the earth, in countries subject to these phenomena, by abstracting and discharging into the atmosphere, from its interior, the redundance of its electricity—would preserve the equilibrium of electric action between it (the earth,) and atmosphere, and thence have the effect of preventing their occurrence. And which, as is not unusual with men of sanguine temperaments, in the first flush of successful discovery, though it may savour a little of what may be called *the poetry of science,* must, in consideration of the motive which dictated it, be entitled to respect, thus proceeds:—

"Les anciens moins éclairés que nous ne le sommes, mais plus hardis ont osé rechercher des moyens pour se préserver des tremblemens de terre, comme je le

dirai, dans un instant; avec plus de lumière aurions-nous plus de pusillanimité? Depuis un petit nombre d'années une nouvelle science, la science de l'électricité semble être sortie du néant; les découvertes les plus brillantes, et en même temps les plus étonnantes ont couronné les travaux des physiciens; ce fluide admirable que nous nommons froidement fluide électrique, a le plus grand rapport avec tous les météores, et particulièrement avec le tonnerre, les tremblemens de terre et les volcans, il en est le principe producteur, *et paroît être l'âme universelle de la nature.*" * * "Les anciens avoient entrevu la nécessité *de creuser des puits profonds pour préserver des tremblemens de terre,* moyen qui a quelqu'espèce d'analogie avec celui que j'ai proposé. Pline, assure que les fréquentes cavernes propres à donner *une issue* au fluide subtil, qui cause les tremblemens de terre, sont un excellent moyen pour les prévenir, c'est ce qu'on remarque dans certaines villes, qui sont moins sujettes aux tremblemens de terre, depuis que plusieurs trous y ont été formés; *crebri specus remedium præbent, conceptum enim spiritum exhalant; quod in certis notatur oppidis, quæ minùs quatiuntur crebris ad eluviem cuniculis cavat.—Hist. nat. lib.* 11, *cap.* 79. Les premiers romains sur-tout, prirent cette précaution de creuser des puits profonds, pour mettre l'ancien capitole à l'abri des funestes effets des tremblemens de terre,

et ils y réussirent, car cette partie de Rome, n'a jamais rien souffert de leurs ravages.

"Les trous perpendiculaires, qui sont sur les diverses montagnes, et les ouvertures des divers autres, sont regardés avec raison comme des soupiraux utiles, (Derham, *lib.* iii. *Théol. phis. cap.* iii.) et on a remarqué que plusieurs contrées ont été entièrement délivrées des tremblemens de terre, après que de nouvelles ouvertures y ont été produites. Depuis le fameux tremblement de terre, qui arriva à Tauris en Perse, le 26 Avril 1721, on a fait creuser un grand nombre de puits très-profonds, et nul tremblement de terre ne s'est fait sentir jusqu'à présent, quoiqu'ils y fussent auparavant très-communs. Ces heureux effets dépendent uniquement de ce que l'excès de fluide électrique, qui est quelquefois accumulé dans certaines régions de la terre, s'échappe par ces ouvertures jusque dans l'air, l'equilibre se rétablissant par ce moyen." *

Thus we may perceive that, both in ancient Rome and in modern Persia, the experiment of sinking deep wells, to serve as *soupiraux*, or vents, for the escape of those exhalations from the inferior strata beneath, whose imprisonment was supposed to be the immediate cause of earthquakes, has been resorted to; and that, if credit is to be attached to the authors

* Bertholon *De l'Electricité des Météores.* Tom. Prem. pag. 403, &c.

cited, it has, in each instance, been attended with success. And, in recommending the application of this remedy in Peru, and the neighbouring districts of South America, which are the most subject to these visitations;—as the subject appears to involve more than what at first meets the view, it may be right briefly to state the grounds on which I found my opinion. In the science of *draining*, it is known, that lighting on and tapping a single main spring, or source of water, has frequently the effect of proving beneficial, at distances which might be supposed to be altogether beyond its range, by drying up a number of subordinate sources with which before, it was not supposed to have any connexion. And thus, that the construction of these soupiraux, or *para-tremblemens* (as Bertholon calls them,) in the countries of South America, and those of the north east of Asia, which are the most subject to earthquakes, might be attended with effects the most extraordinary and unlooked-for, not only in these countries, but in those lying the most distant from them. For, assuming with the last-mentioned author, that electricity and *magnetism* (which as they are considered to be always united in nature, should be esteemed synonymous terms in inquiries of this kind,) to be "*l'âme universelle de la nature*," and consequently, that volcanic eruptions and earthquakes from beneath, as the thunderbolt from above, alike result from electrical agency. It is known to

be one of the distinctive characters of electric action that at one and the same time it generates forces directly opposite, viz. *attractive* and *repulsive*, as shown in the *trombe* or water-spout. And of which opposite actions, as the local force of gravity in the sun and planets is, according to our principles, esteemed to be one; so, the other is considered to be that which holds these bodies detached from each other in their respective orbits. And as in each individual instance, these opposite forces in the sun and planets, are assumed to be exactly balanced one to the other; and that as connected with these bodies collectively, the whole of these forces are combined and blended by the principle of *reflection* in which they have their source: that it is to this peculiar property of electric action to which the double harmony, both local and collective, observable in the heavenly bodies, is to be ascribed. And assuming the action of the electrical and magnetic forces to extend equally into the depths of the earth on the one hand, as into the atmosphere on the other; and that the attraction, in the former case, generated by electric action, converges to the *magnetic axis*, as to its centre, which connects its opposite magnetic poles. According to this, the *repulsive force* in the interior of the earth, generated with the attractive, should act on a different line, and in a different direction to the latter force; and as the attractive force *converged chiefly to the*

tropics,—the *repulsive*, acting on a different line to that of the magnetic axis, as stated, should exert itself chiefly on those regions of the opposite hemispheres which lay at the extremities or poles of this line, or *axis of repulsion*. Now, assuming the existence of such a repulsive action in the interior of the earth: as it would necessarily exert itself most in the direction, and at either extremity of its axis. From so remarkable a coincidence in this respect, as that which exists between the volcanic regions of the opposite hemispheres, lying as they do due S. W. and N. E. or nearly at right angles with their magnetic poles; as if, like the latter, connected with a peculiar line, and diverging from the same centre of action:—do we not in such repulsive force thus generated, assuming it to exist, discover a cause fully adequate to the production in these opposite regions of the earth, of those frequent and fatal effects consequent on the earthquakes for which they are so remarkable? And that, could a means be found, such as that noticed, which applied at the opposite extremes of this the axis of repulsion, by affording a free egress to the elastic matter so transmitted, in such way as to prevent its local accumulation, and the extraordinary energy consequent on its imprisonment,—the effect might be, not only to free the districts where such means were employed, from these destructive visitations, but, perhaps *to sap the source of volcanic action throughout the globe*, in

such way that future ages would—(as in the case of other extinct volcanoes,)—only know of them, by the traces they had left of their destructive effects.—A project which—if practicable—were, it will be admitted, well worthy the ambition of an Alexander to execute! as it were a triumph in the cause of humanity, such, and so colossal, whether in its object or dimensions, as, up to the present, few have imagined,—or, however sanguine, could suppose it possible to realize; and one in all respects worthy—as connected with science—of its heaven-born source.

And as, on electrical principles, volcanic action in the interior of the earth should result less from a local than from *a collective agency*, which, if it existed, would occasionally manifest itself simultaneously in different and very distant places at the same period of time. By referring to facts we shall find that such has frequently been the case; as, independent of other instances which might be cited, it will be sufficient to notice that the tremendous eruption of Mount Hecla, in Iceland, in 1783,—the greatest probably on record, though separated from Calabria and Sicily by nearly half the hemisphere,—if it did not occur at the same period of time with the earthquakes, which during five months convulsed the latter countries on this year, as already stated, (a circumstance which I have not been able to ascertain,) occurred, as will be seen, on the same year: thereby, as must be assumed, proving the ex-

istence of a connexion between these phenomena; as it appears more than probable that, in like manner, a connexion existed between them, and the extraordinary fog of the summer of this year, already alluded to;—and consequently, an additional argument, as would appear, is thus furnished in support of the theory of electrical agency. And assuming it to exist, as it were desirable to ascertain the extent of this connexion of volcanic action, whether on the line of *magnetic attraction*, as in the instance cited; as on the opposite,—being esteemed its true line,—or that of *repulsion*; or, whether it acted simultaneously on both, in the same, or in the opposite hemispheres of the earth: perhaps philosophers would not think it beneath them to direct their attention to the subject. It may be further observed that, did these opposite actions of attraction and repulsion exist in the interior of the earth; independent of their effects as connected with volcanic action, we may readily perceive in them a sufficient cause, not only why a very marked difference—as is the case, should exist in the mineral kingdom, equally as in the climate of the countries in either hemisphere, situated on the opposite extremes of the scale of longitude, or on the first, as contrasted with the 180th degree,—but more particularly in the higher latitudes, where their effects, as in the case of the vol-

canoes, would the most strongly manifest themselves.

Other questions, it will be seen, might be suggested as connected with this subject; such, for instance as the share which these opposite actions in its interior towards the poles of the earth, might be supposed to have in inducing the obliquity of its axis of rotation,—or the effect which might arise from a change of their positions, in *extinguishing the present line of volcanic action*, and, perhaps, of *reopening an opposite*, &c.; but I leave these to be discussed by others: satisfied if, by calling attention as to the possible existence of these actions, my doing so may have the effect of proving serviceable to the cause of science.

CHAP. XII.

Climate, as connected with Locality.

It may be set down as among the most important advantages consequent on an increased acquaintance with the principles and laws of nature, that it frequently has the effect of modifying or changing first impressions. And, ere entering on the subject of *Localities*, as connected with the temperature and weather, it may be well to notice one of the early errors fallen into by philosophers in reference

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appear, had led to nothing; as it was not before the experiments of Mr. Christie, in 1827, connected with the diurnal variation of the compass needle, that any opinion appears to have been entertained that the temperature had its source in electric action.

Again, all bodies, as refers to electricity, are divisible into opposite classes or kinds, technically called *idio-electrics*, and *anelectrics;* or *containing* and *conducting* bodies: the union and mutual action of which on each other by friction, being esteemed necessary in order to the species of *excitement* in which electrical phenomena have their source. And, as the atmosphere belongs to the former, or *containing* class of bodies, (consequently electricity—though Proteus-like, under a variety of shapes—must necessarily be always present in it,) and the mass of the earth with its waters, to the latter or anelectrics, which being acted on by the sun produces electric excitement in the atmosphere; first at the point of its junction with the earth, where this electric excitement and its effect on the temperature is first felt, as the most powerfully developed; and from which it gradually ascends into the superior region. Thus we have the principle on which the *locality* of the temperature is based; as the proof that electric action is never absent from the atmosphere; but that, being, as its effects, of opposite kinds; and between which a continual os-

cillation, whether as connected with the annual or lunar circle, exists, and is progressing; and to the tendence in these actions, (as in similar cases,) mutually to restore the principle of an equilibrium between them, that, as observed by Lord Bacon, "the air, on a balance, is seldom debtor to itself; nor do the seasons succeed each other in the same tenor for two years together;" as will be found more particularly treated of, in the Third Part, under the head of *meteoric progression*. And as in a preceding paragraph it was stated, as being one of the distinguishing characteristics of electrical agency, that it, at one and the same time, originated the opposite forces of attraction and repulsion, to, and from, the same centre of action. Another peculiarity of electricity in its union with magnetism in the atmosphere, no less paradoxical than the former, appears to be, that, together with these attractive and repulsive forces, it at the same time develops the opposite temperatures of *heat* and *cold;* being, as the former, the incorporation, as it were, or union in the same germ, *of opposite progressions of the same kind*,—so conformable to the dispositions of nature.

These results on the temperature being alike opposite in the direction of their development from their common centre, as in their nature and effects. Which peculiarity, it may be observed, is still more strongly apparent in the thunder-cloud, than on the surface of the opposite hemispheres of the earth, at

the solstices; owing to the greater concentration of the electric and magnetic forces in this species of meteoric action, than in that excited by the sun along the extended superficies of the earth. But, notwithstanding that in each species of meteoric action these opposite effects, as connected with the temperature, are the same, and only differ in degree; as the actions are different, the order of progression, in reference to their development on the temperature, is likewise different; the latter being similar to the order of the colours in the double rainbow, entirely reversed. For, whereas in the meteoric action in the atmosphere, derived from the principle of reflection as excited by the sun, the heat converges to its centre between the tropics, and the cold diverges to the pole of the winter hemisphere: in the thunder-cloud, on the contrary, *the cold converges* to the axis, or centre of action, and *the heat diverges.* This disposition is sufficiently proved by the torrents of hail which are occasionally moulded in the *womb* of the thunder-cloud; and by the lightning projected from its *sides.* And, in addition, it may be noticed, that this was the effect experienced by M. Tetu, in his aërostatic ascent into a thunder cloud; in which the cold was so excessive that the mercury in the tube of the barometer sunk five degrees below zero; and the hail and snow collected in his car in such quantity that he was obliged to disembarrass himself of them, in

order to prevent their weight from sinking the balloon. It may be further added, in proof of the correctness of the assumption advanced in reference to the peculiarities of electric and magnetic action, viz. that both attraction and repulsion, heat and cold, and all the other contrarieties of nature in the physical world, should have emanated from the same source of action; that it was absolutely necessary in order to uphold the principle of *unity*, on which the whole of her dispositions therein are based, that these the principles in which her active forces concentrated, should have been so constituted. For it was impossible on any other to establish an order of things which, at the same time that it admitted of such an infinite variety, whether in its periodic aberrations or in its details, from its being so poised and balanced on the same common centre of action, should, in its eccentricities, be circumscribed within certain determinate limits, in such way that the sustaining principle, or *equipoise*, on which its permanence depended, should not at any time be so deranged, but that by means of the controlling forces thus provided, it should be again restored; and immutably remain unaltered: containing, as it thence would have done within it, the principle of its *restoration*, equally as of its renovation.

These observations I consider the more necessary in this place, as in the preceding notice of climate, in its connexion with the geographical distri-

bution of animals and plants, it was chiefly considered in reference to the influence exercised on it by the difference of magnetic action; and this with a view the better to understand the nature of the influence which,—owing to its being, as assumed, derived from the principle of *reflective action*,—certain classes of *localities* exercise on the temperature of the seasons, and changes of the weather, other circumstances being the same. It being of the nature of meteoric action in the atmosphere, that, of whatever kind, it converges to a particular centre or focus, where it is most powerful. And as throughout the year, with the exception of the equinoxes, the position of these foci are determined either by the latitude of places, or by the nature of the locality; and that the influence exercised by the first is uniform, and sufficiently known; whereas that exercised by locality, though frequently more powerful, is less understood; I shall confine myself chiefly to the latter.

Locality, in its most comprehensive sense, as connected with the temperature and weather of the seasons, owing to the unity of the solar and planetary actions on which they depend,—embraces at once, or within the same view,—the opposite hemispheres of the earth. And between these the opposite hemispheres, owing to their being traversed throughout their extent by the axis of magnetic action, equally as that of the earth's rotation, combined

with the law in reference to the *relative direction* of electric action, in its connexion with magnetic,—a *contrast,* in reference to the opposite actions of the sun—electric and magnetic,—always exists. Thus, (being a necessary consequence of the divergence of opposite temperatures from the same source, and of the unity in the actions by which they are induced,) the maximum force of the former, or electric action of the sun, is collected on the summer hemisphere, about the same period that the maximum force of its magnetic action is collected on the opposite or winter hemisphere; which causes that the opposite extreme degrees of annual temperature in these the opposite hemispheres of the earth occur about the same period of time. A similar disposition, in reference to the division, direction, and local position of the opposite axes and main foci, of these the electric and magnetic forces, whether in the sun or planets, being esteemed to result in all cases from their union; and to exist equally in the smallest of the satellites, as in the earth, or in Jupiter. As, whether in a globular meteor, or in the largest of the fixed stars, wherever electric and magnetic action, in a detached state, are united; the laws by which they are governed, in regard to their mutual relations, equally as in the development of their effects, are esteemed to be the same. Such, in its most comprehensive bearings, being the meaning

attached by our theory to the term *locality;* and which, it will be perceived, as regards the principle of temperature, results from the relative position of places in either hemisphere during the opposite seasons of summer and winter, to those occupied by the main foci of the electric and magnetic forces. And thus locality, in this point of view, is synonymous with *latitude;* as the variations in the temperature, whether in winter or summer, which originate in this cause, are simply the results of the modification in the operation of the same laws, incident to the difference which, on the extended scale of their operation in either hemisphere, occurs in the relative position of places in reference to those occupied by the respective centres or main foci of the opposite actions, from which they emanate:—being greatest as we recede from, and less as we approach nearer to these centres,—other circumstances being the same.

But, in approaching nearer, and examining in detail the various members of which the superficies, or reflecting surfaces of either hemisphere are composed; we shall perceive, however rudely traced, that they present the elements of a mechanism, or an adaptation of parts to their ends, such as must convince the most sceptical, that *design* and not *accident* presided over their disposition. For, assuming the principle of *reflective action* to be that, on, or connected with which, the temperature, and other

phenomena of the atmosphere depend:—as the reflecting surfaces presented to the solar action by the *land* and *water* superficies of the earth,—considered as *reflectors*—are unequal in their forces; land being more powerful than water surface, owing chiefly to the stream of evaporation continually ascending from the latter, which thus to a certain extent neutralizes its reflective power on the temperature. Thus it follows, that next to the differences in the temperature, consequent on the difference of latitude, are those induced by the difference subsisting between the land and water surfaces of the earth: and which thus, in their grand outlines, necessarily divide its land and water superficies into opposite classes of localities. And as meteoric action in the atmosphere is of opposite kinds, of which that connected with the temperature is but one; and with which no more than a particular class of those localities is identified, and that the remainder are more particularly connected with the species of meteoric action in which the formation of rain has its source. Thus it follows that the land superficies of the earth, such as continents and islands, is more particularly connected with the temperature; as its water superficies with the species of meteoric action in which rain has its source. And as the laws which govern the operations of nature are observed to be the same in detail as *en grand;* and that the relative forces of the reflecting

surfaces presented by the land superficies of the earth to the solar action, are proportioned to their *dimensions*. Thus it is that the action of continents and the larger class of islands, whether in rising or lowering the temperature, according to the season, is more powerful than that of the smaller, or ordinary class of islands,—other circumstances being the same. And that from the law of *convergence*, the action of these reflectors on the temperature, is more powerful as we approach their centres, or the positions occupied by their local main foci, and *vice versâ*; which will sufficiently account for the difference in the range of temperature, both in summer and winter, which exists between islands and the interior of continents, though lying within the same parallels;—a difference so considerable, as is known, as sufficiently proves the correctness of the principle noticed.

Again, the local atmosphere of the earth, equally as its temperature, is, as assumed, the creation of reflective action;—and, as being a necessary consequence, the effect of this action on the temperature is something like that of gravity, in the inverse ratio of the squares of the distances from the earth's surface. And thence, as the land surface of the earth projects beyond the plain of reflective action presented by that of its waters; were it not that the reflective action of land is more powerful than that of water,—the surface of the latter, as constituting the

lowest level of the reflective action of the earth, were, of the two, the more powerful reflector. And as in addition, the land surface is divided into plains and mountains; and consequently, owing to the cause assigned, that a still greater difference and falling off, exists between the reflective powers of the former as contrasted with the latter, than between the land and water surfaces, as noticed. Thence a further division of the land superficies into opposite classes of localities;—of which the plains are more particularly connected with the principle of temperature; and the mountains with the species of meteoric action in which the formation of clouds and rain have their source. The difference of the effects on the temperature, incident to that subsisting between the reflective power of plains, as contrasted with the sides and summits of mountains, being more strongly marked in the regions of the torrid zone, than elsewhere. And as an approach to the same meteoric effects whether on the temperature or weather, is induced by capes, headlands, and the vicinity of the sea, as by mountains in the interior of continents; it were a curious, and not unworthy subject of inquiry, to ascertain the proportion which exists between the opposite principles in meteorology, of *horizontal extension* from the local centres or foci of reflective action in the interior of continents and islands, on the one hand, and that of *vertical elevation* from the lowest, or water level of reflective ac-

tion, on the other;—circumstances of latitude being the same. For though the falling off in the effect of reflective action vertically on the temperature, has been stated to be something in the proportion of the inverse ratio of the squares of the distances; this is no more than supposition, and does not come up to the real amount. In the estimation of St. Pierre, this falling off in the force of reflective action is so considerable, that it were doing both him and the subject injustice not to quote him in this place:—"Si vous vous élevez dans une montagne, située dans notre latitude, seulement de *vingt-cinq toises* de hauteur perpendiculaire, vous changez de climat comme si vous aviez fait *vingt-cinq lieues* vers le nord; en sorte qu'une montagne de douze cents toises perpendiculaires, nous présenteroit une échelle de végétation, aussi étendue que celle des douze cents lieues horizontales qu'il y a à-peu-près d'ici au pôle; l'une et l'autre se termineroient *à une glace perpétuelle. Chaque pas que l'on fait dans une montagne, en s'élevant ou en descendant, change notre latitude;* et si on en fait le tour, chaque pas change notre longitude."—*Etudes de la Nature.* Tome second, pag. 426. Such, without referring to principles, are the observations of St. Pierre, on this subject. And, that the analogy between the variation of climate along the ascending scale of latitude, from the equator to the Pole, and that encountered in ascending the higher ranges of moun-

tains between the tropics, is borne out not only by the difference of temperature, but, to a certain extent, by that observable in the animals and vegetables found on, or proper to them, no person at all conversant with the subject will deny. It is right to remark, however, that the variation of climate in the ascent of a mountain—as connected with its base and summit—is not *uniform;* but, on the contrary, may be said to go on increasing by a sort of geometrical progression with the ascent, in such way, that at a certain elevation on its side, three feet perpendicular, induce probably a greater change in the mean temperature, than thirty at its base. This being a necessary consequence of the rapid falling off in the effect of the reflective action from beneath, in proportion as we ascend from the plain of its projection on the earth's surface. And thus it is that certain birds and plants of the higher latitudes, are occasionally encountered in the more elevated regions of some of the mountains of the torrid and temperate zones;* and that the strawberry and other plants of the north, are found to flourish at a certain elevation on these mountains, though totally

* "A naturalist of Rome, Mr. Springlen, has formed, with considerable taste and expense, a complete collection of the birds of the Alps, which consist of about five hundred specimens. *It contains the species peculiar to every climate, from the south of Italy to the north of America.*"—See marginal note to the Appendix of *Williams' Switzerland*, page 232.

unproductive when planted in the plains beneath. Nature thus in her productions indicating the approximations which, without any infraction of her laws, so frequently arise out of that constant tendence, so characteristic of her dispositions, to reconile opposites. And, as being connected with which, may be noticed an error fallen into by the generality of astronomers, in concluding,—from the sun's remaining during summer a few days longer in the northern than in the southern hemisphere, that a higher degree of mean annual temperature in the former is the result. This, as assumed, not being the case; as what the southern hemisphere loses *in time,* is compensated for in *distance*:—the southern hemisphere, as is known, being *nearer* to the sun in summer than the northern; in such way, that the relative mean temperature of both is esteemed to be the same.

But to resume the subject of locality as connected with the weather. The influence exercised by the opposite classes of localities on the weather, results altogether from the difference of their effects on the temperature. This is sufficiently proved by the circumstance that they exercise no influence of any kind on the weather, about the periods of the equinoxes. But in proportion as from the latter periods we approach those of the solstices, and that, according to the season, the temperature advances, or recedes to its opposite extreme annual degrees; the

difference of the meteoric influence exercised by the opposite classes of localities on the weather, becomes more and more visible; and thence again, from after the opposite extreme degrees of annual temperature, this influence gradually disappears as we approach the periods of the equinoxes. And which, as connected with mountains, capes, and the vicinity of the sea, is to be accounted for by the blending of opposite temperatures, and consequently of *opposite actions*—electrical and magnetic—which, during the solstial seasons, they induce in their atmospheres. The amount of the influence on the weather thus exercised by the latter class of localities, being always proportioned to the amount of the contrast in the temperature, which, at the time, subsists between them, and the interior of the neighbouring plains. Such contrast, as connected with *mountains*, being greatest in summer: and as connected with capes, headlands, and the vicinity of the sea, *in winter*. From this it follows that, as we know to be the case, mountains exercise a more marked influence on the weather in summer, than capes or headlands; and that, on the contrary, the latter, to which may be added islands lying in the vicinity of continents,—exercise a greater influence on the weather during winter, than mountains. And as rain, during summer, but particularly in the lower latitudes, is usually accompanied by *thunder*, and

during the winter months by *storm*. Thus it is that both rain, hail-storms, and thunder, are more frequent in the vicinity of mountains than of capes, &c. during summer; and, on the contrary, that storm and rain is more frequent in the vicinity of the sea, but more particularly in the neighbourhood of capes and islands, than in mountains, during winter; other circumstances being the same. For, as being in contrast with the dominant action of the sun during both seasons on plains and the interior of continents,—mountain-tops, equally as capes, headlands, and islands, though differing in degree,—are, to all intents, *magnetic conductors in summer*, and *electrical conductors in winter*. To which is to be traced the fearful celebrity of capes in winter, and of mountains during summer; the first for the number and violence of the gales in their vicinity; as the latter for hail and thunder-storms, as noticed. For, as the temperature on the summits of mountains during summer, is much colder than at their base; on the contrary, during severe winters, the temperature on the summits of mountains—however strange it may appear—is much *milder* than in the neighbouring plains by which they are surrounded; being, of itself, a sufficient proof that *cold*, the same as *heat*, results from an *active agency*, and that, as in the latter case, the principle on which its activity in the heavenly bodies is based, is *reflective ac-*

*tion.** Of this the *reversed scale* of atmospheric temperature, vertically, during severe winters, the following fact published in the Paris *Constitutionnel*, of the 7th February, 1830, (reported in a former work of mine,) may be cited in proof, viz. "D'après les rapports unanimes de tous les voyageurs arrivant d'Italie, au moment où les routes dans l'intèrieur de la France et de l'Italie sont encombrées de neiges et de glaces au point d'entraver partout la marche des fourgons accélérés, et même des diligences et courriers, la route du Mont-Cénis, en quelque sorte privilégée, a été depuis le commencement de l'hiver exempte de neige, *et ce point si élevé*," (8000 feet above the level of the sea,) "*a joui d'une température beaucoup plus douce que la nôtre.*" And that the same difference occurs between the temperature in the interior of continents, as contrasted with islands, capes, and the vicinity of the sea, during winter and summer, the climate of Ireland furnishes a sufficiently striking illustration; in regard to

* In reference to the principle of *reflective action*, the following observation from St. Pierre's *Etudes de la Nature*, tome second, pag. 67, will probably be considered curious, as showing the antiquity of this doctrine to be as remote as the time of Pythagoras:— "Philolaüs de Crotone, un de ses disciples, prétendoit *que le soleil recevoit le feu répandu dans l'univers et le réverbéroit*, ce qui explique mieux sa nature que les émanations perpétuelles de chaleur et de lumière que nous lui supposons sans réparation et sans épuisement."

which Humboldt observes, that "Ireland presents one of the most remarkable examples of the combination of *very mild winters*, with *cold summers*; the mean temperature in Hungary for the month of August is 71. 6°; while in Dublin it is only 60. 8°. In Belgium and Scotland the winters are milder than at Milan."* It is scarce necessary to add, that the variations and peculiarities of climate here noticed, are only explicable on the principles assumed by our theory. And that, in the changes of the weather which take place both in summer and in winter,—the transitions from fair to rainy weather, always commence in the vicinity of the sea or of mountains; and that the changes from rainy to fair weather, on the contrary, have their commencement in the interior of continents and islands; whence they extend to the opposite class of localities.

CHAP. XIII.

Connexion of Magnetic Action with the Formation of Rain in the Atmosphere.

And, in pushing still further our inquiry in reference to the influence exercised by a certain class of localities on climate, we shall find not only new

* See Ure's Dic. of Chem. art. Climate, p. 226.

matter worthy of attention, but still further corroborative of the correctness of our principles. Thus, in treating of the assumed connexion of climate with the phenomena of earthquakes, notice was taken, in a preceding chapter, of the extraordinary fact as to the *total absence of rain* at Lima, and in that part of Peru. And in examining the climate of other countries in either hemisphere, situated on the opposite sides of the higher ranges of mountains, but more particularly where their *direction* is not parallel with that of the *magnetic meridian*, but that they cross it at angles more or less considerable—we shall find, though perhaps not to the same extent as in the climate of Peru, that a marked difference, in reference to relative drought or humidity, exists in the countries lying on either side. And further, that such difference is always in accordance with the relative position of such countries, in reference to the more proximate magnetic pole of the earth. Thus, in Scotland, we find that more rain falls on the western than on the opposite or eastern side of the mountains by which it is divided. This difference being still more strongly marked in the countries lying on the opposite sides of the Alps and Pyrenees: the greatest humidity of climate being, in every case, on the side of such mountains which lies in presence of, or exposed to the action of the proximate magnetic pole; and the greatest drought on the opposite; or where, from the operation of

these natural barriers in excluding it, such polar action is less powerful. And, it must be admitted that, when such effects as these are found to be always constant in their relations, they go to prove, in a manner the least equivocal, the existence of a connexion between the magnetic pole, and the meteoric action in the atmosphere in which the formation of clouds and rain have their source. For, in no other way can we account for the existence of differences such as these, and so strongly contrasted with each other, in proximate regions of the atmosphere, where circumstances of latitude are the same, or so slightly different as to be totally incapable of producing any such effects.

Now, considering this subject to be one which, on various accounts, is most deserving of attention: as partial views are seldom correct ones; together with reverting to first principles, it becomes necessary to examine it a little in *its collective relations*, the better to enable us to arrive at, and form, just conclusions.

The *magnetic meridians*, extending from either, to the opposite magnetic pole of the earth; placed between opposite meteoric reflectors, of which the surface of the earth is one, and the most proximate, and the sun's disk the other and most distant; and being thence the creation of reflective action: though thus reposing on the superficies of the earth at its opposite extremes, are throughout the remainder of

their extent detached from it; and describe in their course a series of extended arches, of which the culmens or summits are at the Line; and from which, as they diverge on either side, as shown by the dipping needle, they approach nearer to the earth; till having arrived at the magnetic poles and term of their extreme range, they concentre, in coming into contact with it. But, as magnetic action in the atmosphere is never detached from, but, on the contrary, is inseparably united with electric; and that the whole of its phenomena are esteemed to have their source in the combined action of these forces. Thus it is that these the magnetic meridians may justly be esteemed as the *axes* of meteoric action in the atmosphere; from, or to which, according to the species, it continually *diverges*, or *converges*: and which thus, as being connected with the latter species of this action, necessarily constitutes the region of the clouds, as being that in which it concentrates. And that this is no ideal supposition, together with the evidence obtained from the dipping-needle alluded to; the marked difference in regard to the elevation at which the clouds *form* in the lower latitudes, as contrasted with those lying further north or south; and in summer, than in winter, sufficiently proves. Insomuch, that this the arch*

* The arch, described by the *line of congelation*, and which at the Line is 2400 fathoms (or 14400 feet,) higher than the surface of

formed by the magnetic meridians throughout the extent of the atmosphere, from pole to pole, may justly be considered as constituting the meteoric *charpente*, or sustaining ground on which it reposes.

These circumstances premised, and assuming the concurrence of magnetic action to be equally necessary to the formation of the *nimbus*, or rain-cloud, as electric; it is easy to see that an obstruction, such as that presented by the higher ranges of mountains, to the free horizontal circulation of magnetic action; but more particularly when, as in the cases supposed, they traverse its course, or the direction of the magnetic meridian,—should induce effects on the climate of the regions lying immediately on the opposite sides, exactly similar to those noticed: a greater proportion of rain being formed in the atmosphere on that side of such mountains which lies open to, or exposed to the action of the more proximate magnetic pole of the earth; and a less proportion on the opposite, agreeable to the greater or less elevation of such mountains; and to the latitude. For it is easy to see that, from the greater elevation of the arch formed by the magnetic meridians in the lower, than in the higher la-

the sea; from thence as it diverges north and south, gradually approaches nearer to the earth, till at about the 80th degree on either side, it comes into contact with its surface.

tudes of either hemisphere, a greater elevation in such mountains, as in the case of Peru, were necessary to the production of such effects in the countries of the former than in those of the latter; other circumstances being the same. And thus, together with the cause of these variations, and with the data necessary to make them available to objects of utility, we have, as noticed, an additional proof of the correctness of the principles assumed by our theory, in reference to the source and formation of rain in the atmosphere.

Having thus, as I assume, succeeded in showing the necessity which exists for the presence and concurrence of *magnetic action*, equally as of electric in the formation of clouds and rain: and consequently, that it is by means of the concurrence and union of both actions in the middle region of the atmosphere, equally as at the surface of the earth, in regard to the temperature, that this species of meteoric action is induced; the circumstance is well calculated to call forth a more particular inquiry in regard to the principle in which this and its accessory phenomena have their source, than what we have yet extended to them.

It was observed, in a preceding chapter, that, as refers to electricity, bodies were divisible into opposite kinds, denominated *idio-electrics* and *anelectrics*, or containers and conductors of electricity:

and that in order to the production of the excitement in which electrical phenomena have their source, the action of the former on the latter, or of the latter on the former was necessary; as such excitement was only obtained by means of such a conjoint action. And that, under this point of view,—of the thermo-electric combination formed by the earth and its atmosphere, in reference to the principle of temperature, the region of the latter which lies nearest the earth, constitutes the ideo-electric, and its superficies, on which this region reposes, the opposite or analectric portion; by means of whose *reflective* and *conductive* powers, acted on and excited by the sun, the meteoric action is generated in this region of the atmosphere, in which heat, or the principle of its temperature has its source: the latter, as should be the case according to these principles, being greatest at the surface of the earth, or focus of the excitement in which this species of meteoric action is generated, and gradually less in proportion as we recede vertically from it; till, at a certain elevation, the effects of this reflective action on the temperature disappear *at the point of congelation.* But as meteoric action in the atmosphere is of *opposite kinds,* of which that connected with the temperature is but one, and confined in its range to a particular region; and that, in order to the production of the other, or that in which clouds and rain have their source, though connected with

the superior region of the atmosphere, a similar arrangement in reference to the presence and union of an *anelectric*, with the *idio-electric* body, formed by the superficies of this its inferior region, became equally necessary as at the opposite side, or superficies of the earth. In directing our attention to the *construction* observable in this our local atmosphere, vaulted, as it were, throughout its extent, at a certain elevation, by the magnetic meridians, in traversing it from pole to pole, along the line of congelation. Do we not, I say, from the marked affinity observable between magnetism and *iron*, equally as the remainder of what are called electrical *conductors*,—in this the *magnetic vault* suspended over, and enclosing the idio-electrical region of the atmosphere, which extends from the superficies of the earth to the line of congelation, equally as in the anelectric pedestal on which it is based on the opposite side, and intersecting as this magnetic dome, in its direction, does, that of the electrical currents which are, (owing to the law in reference to the opposite direction taken by electrical and magnetic currents,) continually moving beneath,—discover the elements of an arrangement and mechanism, such, as are altogether adapted to the production, alternately, of these the opposite species of its meteoric action, by which, together with the principle of its temperature, that of the revolution continually progressing between it and the waters of the earth.

beneath, is upheld? And in which, together with the true nature of the difference subsisting between the opposite forces of electricity and magnetism, we may perceive the wise intention of Nature in uniting in the atmosphere, forces such as these, which by reason of the contrasts they present, *are so admirably adapted to serve as foils to each other*, in calling forth and eliciting by this their conjunction, as already noticed, the respective latent energies of each.

CHAP. XIV.

Further Circumstances connected with the opposite Species of Meteoric Action in the Atmosphere.

AGAIN, it being of the nature of meteoric action in the atmosphere, that, of whatever kind, it converges to a principal or main focus, where it is most powerful; and that the opposite species into which it is divisable, are as opposite to each other in their nature, as are the electrical and magnetic forces from which they are derived: and further, that, as being at once the bases of the temperature and remainder of its phenomena,—it is the variations in the species of meteoric action in the atmosphere derived from the principle of reflection, which determine those of the opposite species. Thus it is that the opposite action of the sun as reflected from beneath,

separate and diverge horizontally on the earth's surface from a common centre, to directly opposite points of its superficies;—its electric action concentrating at the line, and its magnetic, diverging thence to the opposite poles, but more particularly centring at the pole of the winter hemisphere. This division in the action of these forces being more strongly apparent at, and after the solstices as we approach the opposite extremes of annual temperature, than at the equinoxes or other parts of the year; and more fully developed at and in the vicinity of their opposite main foci at the line, and pole of the winter hemisphere, than throughout the intermediate regions by which they are separated.

It would follow, assuming our principles to be correct, that as the reflective action of the sun is most powerful at the solstices and in the vicinity of its opposite main foci; that these are the periods and regions of the atmosphere, either at, or where, the species of meteoric action in which clouds and rain have their source, is least frequent. And, on the contrary, that at the equinoxes, generally, as at and after the periods of the solstices in those regions which are the most distant from the sites occupied by the opposite main foci of reflective action, were those at, or where the latter, or species of meteoric action in which clouds and rain have their source, should the most frequently occur, other circumstances being the same. And by contrasting our

principles with these the facts to which they refer, we shall find them in all respects borne out by the latter:—and thence that, according to the dispositions of nature, each species of meteoric action in the atmosphere as connected with the temperature or opposite class of its phenomena, has *both a season*, and *a locality*, equally as a ground or axis proper to itself. But as the current of meteoric action in the atmosphere progresses uninterruptedly, and that these its opposite species cannot progress at the same time in any of its regions; and consequently, that the period of the termination of either in any region, may be considered as that of the commencement of the opposite. This necessarily leads us to inquire as to the nature of the principle in which these changes have their source; and this, in all cases, we shall find consists in *the loss of the equilibrium* of the existing action. And thus, as where the existing action is the most powerful its equilibrium is the most difficult to be disturbed, and *vice versâ*; it follows that there is always a strict analogy between *the force* of the existing species of meteoric action, and that of *its equilibrium:* for as the force of reflective action is greatest at and in the vicinity of its main foci in summer and winter; in those regions of the atmosphere during these seasons also it is, where the equilibrium of this action is likewise the most powerful: and *vice versâ*, as

refers to the middle latitudes and opposite seasons of the year.

It thence follows, that the sustaining principle of *reflective action*, is that of *disparity* between the opposite actions of the sun; as the greater is the latter, or inequality subsisting between these actions in any region of the atmosphere, the greater the force of the dominant action on the temperature, and of the equilibrium of this the species of meteoric action it induces. And where on the contrary, a close approximation of the relative forces of these the opposite actions of the sun, subsists in any region of the atmosphere, and that the amount of such disparity is inconsiderable; the force of the dominant action, as of the equilibrium of the meteoric action it induces, is likewise inconsiderable. And as a graduated scale of disparity in the relative forces of the opposite actions of the sun exists in the summer hemisphere from the tropic to the pole;—being greatest at the former and least at the latter; as in the winter hemisphere contrariwise, or from the pole to the tropic. Thus it is, that a *moteur*, or disturbing cause, which at one extremity of either hemisphere during summer or winter, would, owing to the weakness of the equilibrium of reflective action, overthrow it, and occasion a commencement of the opposite species in which clouds and rain have their source, would produce no such effect at the opposite, or in the vicinity of the main focus of

the existing dominant action of the sun. From this it follows, that as, or in proportion to the force of the equilibrium of reflective action in any region of the atmosphere, must be that of the *moteur*, or disturbing cause, by which it is overthrown. And as from the difference in the reflective power of mountains in summer, and of capes and the vicinity of the sea in winter, as contrasted with the interior of plains or of continents; and the consequent difference of force in the equilibrium of reflective action during these seasons in the former, as contrasted with the latter; thence its more frequent overthrow, and the occurrence of rain, consequent thereon, in mountains during summer, and in the vicinity of the sea during winter, than in the opposite class of localities noticed, circumstances of latitude being the same.

And, in reference to the *disturbing cause* alluded to, by which the equilibrium of the reflective action of the sun is overthrown. As the dominant action of the sun which induces the equilibrium of its reflective action, cannot be disturbed *by itself*; it follows that, throughout the year, it is the *weaker* action of the sun, that must be the disturbing cause by which the equilibrium of the meteoric action of its opposite the dominant action, is overthrown. And thus, as from the period of the equinox to that of the succeeding solstice, both in the summer and winter hemisphere of the earth, the existing dominant action of the sun is in a state of continual in-

crease or progression; and its opposite in an equally continual state of decrease or retrogression: it would follow, according to these principles, that did there not exist a meteoric agency *distinct* from those of the sun and earth, whose action on the atmosphere, by uniting with the opposite actions of the sun alternately, increased by the sum of its amount, the force of either during the period of its countenance; and thus by altering its measure when united with the *weaker*, by the increase it induced, should overthrow the equilibrium of the reflective action of the opposite or dominant force, —that during these the opposite *progression* seasons of the year, a change of the weather to rain could not take place. And thence, as the only agent which by reason of its homogeneity could induce such effects, were *the moon*; the fact of the occurrence of rain during these periods of the year, is of itself demonstrative of the existence; as its frequency, of the extent of *the lunar action on the weather*: it being, as stated, the only disturbing cause, viz. its negative or *magnetic action* at the syzygies, and quadratures during the summer progression quarter, and its positive, or *electric action* during the opposite seasons,—which could induce these changes to rain. This, however is not the case during the opposite or *transition quarters*, viz. those which commence at the solstices and terminate at the equinoxes: as it is during these quarters that

the progressive increase of the weaker, and decrease in its opposite the stronger or dominant action of the sun, in both hemispheres take place; till the principle of an equilibrium between their relative forces which during the preceding quarters was lost, becomes again restored at the periods of the equinoxes. To this cause, and the increasing weakness of the equilibrium of reflective action incident thereto, it is, that the lunar changes during these periods induce such general and frequent overthrows of the latter; and that in consequence, in either hemisphere of the earth, they are the chief rainy seasons of the year. And further that, as the force of the lunar action is limited in its amount; and, except when favoured by the vicinity of mountains, or of the sea, that it is in consequence unable, during the opposite *progression quarters* of the year, to overthrow the equilibrium of reflective action in the vicinity of its opposite main foci at the tropic or pole; that these the transition quarters are those only during which the species of meteoric action in which rain has its source, can be said to occur in the regions which approximate to these main foci.

And thus, in tracing as to its source this the meteoric action by which clouds and rain are formed, we shall find that it is referable to the *transition*, or passage from a preceding, to a subsequent state of reflective action, incident to the interruption in

the latter species, caused by the temporary loss of its equilibrium. And that, as the principle on which it, *reflective action*, depends, is, as stated, a *disparity* between the relative forces of electric and magnetic action, and their local separation and divergence from a common centre or axis, situated at the line of congelation, to the opposite, or superior and inferior regions of the atmosphere, incident thereto:—*that*, on the contrary, on which this the opposite species of its meteoric action is based, is the temporary *equalization*, and reversed or concentric action of these forces on this the axis, in common, both of their *divergence* and *convergence*, which separates horizontally its opposite divisions, electric and magnetic:—and which thence may appropriately be denominated the *inverse*, as its opposite the *direct* or divergent species of meteoric action. And thus, that, as soon as the equilibrium of the latter or direct species of meteoric action in any region of the atmosphere is overthrown, the site of its meteoric action is thence transferred from the surface of the earth beneath, and from the superior region above the line of congelation, to this its centre; where the contrast which exists in the *direction of the currents* equally as in the nature of the magnetic and electrical forces on either side, thus brought into collision with each other, constitute the idio-electric and anelectric principles or ground on which it forms; and from which, in proportion

as the clouds it engenders increase, it extends itself on either side, accelerating as it progresses; till, if sufficiently rapid, thunder and its accessories are developed. The period of its duration being proportioned to the amount of the *secousse* or overthrow sustained by the equilibrium of the opposite action, in which it originates; and to the velocity or slowness with which, (according to the *contrast* subsisting between the opposite action—electric and magnetic—the season and nature of the locality,) it progresses.

That a reversed action of the electric and magnetic forces from either side, on the middle region of the atmosphere in the formation of rain, similar to that assumed, takes place on such occasions; not only the fall of the mercury in the tube of the barometer, but the variations of the compass-needle which this species of meteoric action, when considerable, induces, sufficiently proves. As it is only the temporary attraction to the axis of this species of meteoric action in the middle region thus engendered, which by coming into collision with that of gravity, generated by the collective action of these forces throughout the body of the atmosphere on the mass of the earth beneath, combined with the derangement in the direction of the magnetic meridian derived from such collective action, thus induced, which could produce these effects. And, in the higher ranges of mountains during summer, where, owing to the weakness of the reflective ac-

tion of the sun, and the consequent weakness of its equilibrium in the atmosphere, the frequent changes which at times take place between this and the opposite species of meteoric action in which rain has its source, are so palpably expressed by the sudden formation and disappearance of clouds on their sides and summits, that it has frequently attracted the attention of travellers in such regions to the circumstance. Of this, the following extract from the writings of the celebrated *Arthur Young*, while resident in the Pyrenees, will serve to convey an idea:—"The heights of the mountains is such, that the clouds, perpetually broken, pour down quantities of rain." * * "They do not only arrest the fleeting ones which are passing in the atmosphere, *but seem to have a generative power;* for you see small ones at first, like thin vapour rising out of glens, forming by degrees, till they become clouds, heavy enough to rest on the tops, or else rise into the atmosphere, and pass away with others."—*Travels in France*, vol. 1, page 57 and 58. And from having frequently witnessed in those mountains the circumstance here alluded to, I can say from my own observation, that the line on which these clouds commence to form, is always that described by *the base of the snows* which continually rest on their summits; and which thus forms the boundary between their opposite regions, electric and magnetic. The principle assumed in reference to the source of this

species of meteoric action in the atmosphere, being in this instance proved by the fact; and from its being so near and palpable, in a manner as little liable to error or deception, as though it passed within the precincts of a laboratory.

CHAP. XV.

The Winds, or Currents of the Atmosphere.

AGAIN, as, according to the law of electrical and magnetic currents, when, as in the atmosphere, the action of these forces is combined, they cross each other at right angles; and that it is the position of the magnetic meridian which determines that of its opposite, the electrical. And that, as we perceive, these opposite meridians in their direction, look to the opposite cardinal points of the world:—it were probably not only curious but important to ascertain the connexion which *the winds* or currents of the atmosphere have with the axes formed by the meridians of these opposite actions of the sun; but more particularly during the opposite seasons of summer and winter, or periods of their alternate *domination* and *retrogression*. For, as the axis of the winds, or that on which they progress, as observed in a preceding paragraph, is always at right angles with their course or direction; and that the same ana-

logy exists between the electrical and magnetic currents induced by the opposite actions of the sun; and that the current in the inferior region of the atmosphere originated by the existing dominant action, particularly in the vicinity of its main focus,—as proved by the trade-winds of the tropics,—has for axis, that of its opposite, the weaker action of the sun, and is, in consequence, on the line, and in the direction of its progression. It would follow, assuming the existence of a connexion between the currents of the atmosphere and the axes formed by the opposite actions of the sun in its body, that as the changes in the weather to rain, are, as shown, induced by the changes which take place in the *weaker* action of the sun; that in like manner *it is the axis of the latter action, which determines the direction of the winds.* And as, with the change of the seasons, *that* which, during six months, had been the retrogressive or weaker action of the sun, becomes in turn, during the succeeding six months, the dominant or more powerful action;—this will, probably, help to explain the source of the periodical changes which half-yearly take place in the direction, not only of the trade-winds and other currents of the tropics, but generally throughout the different regions of the opposite hemispheres. And, as from the tropics we advance to the higher latitudes, and that the opposite actions of the sun become more nearly balanced one to the other,—thence why it is,

that, as partaking more equally of both, the axes, as the direction of the winds, vary from the true axes of both actions; forming, as the winds in the middle latitudes usually do, angles more or less considerable with the cardinal points; and that they but seldom, as in the vicinity of the tropic or pole, are in their direction parallel with the axis of the dominant action. Which, assuming these data to be correct, would give us a truer idea of the theory of the winds, than what, as far as I am aware of, has yet been proposed on this important subject. And if, as assumed, the axis of the weaker action of the sun, determines in all cases the position of the axis of the winds; and that their direction can no longer be considered as depending on *accident*:—as by means of a knowledge of the lunar action on the weather, those acquainted with it will be enabled to see in advance the periods when storms are to be apprehended; the principles noticed, will likewise enable persons to ascertain *their direction* at these the periods when they are expected to occur, with the same certainty as other effects in physics, whose principles are known. Observation, however, will be required, in order the better to ascertain the various bearings of this subject; with the view of giving to it, as connected with navigation, all the utility of which it is susceptible. It is hardly necessary to add, that the position of the axis of the winds in the atmosphere, as here understood, is that of the line of

congelation in its middle region. Again, as with the exception of the equinoxes, when, from the equalization in the times, or length of the day and night throughout both hemispheres, that the opposite actions of the sun—electric and magnetic—are equally balanced one to the other; a difference between the relative forces of these actions exists throughout the remainder of the year. This causes that during the opposite seasons of summer and winter, these the opposite actions of the sun on the atmosphere, are, as noticed, divisible into a *dominant* and *subordinate* action;—the electric action of the sun during summer being the dominant, and the magnetic the subordinate action; and at the opposite season of the year, or during winter, *vice versâ*. And it being, as assumed, the changes in the subordinate or weaker action of the sun, which during these seasons induces the occurrence of rain; and that under this point of view, these the opposite actions of the sun are further divisible into an *exciting* and a *sustaining force*, which change their positions relatively with that of the seasons. To this the change which takes place in *the ground of meteoric action* in summer and winter, is probably owing the marked change which takes place in the *accessory phenomena* by which rain is usually accompanied at these opposite seasons of the year.

The better, however, to understand this, equally as the principle in which the winds have their source,

it becomes necessary to recur to the circumstance as connected with electric or meteoric action in the atmosphere already noticed, viz. that it originates at one and the same time directly opposite forces—*attractive* and *repulsive.* Which circumstance is only to be accounted for on the principle of the opposite directions taken by electric and magnetic action when, as in the various meteors of atmosphere, combined. This, in the first place, causes, that, as connected with the atmosphere of the opposite hemispheres of the earth, *the position* of the magnetic meridians on either side, is that which determines both the position and direction of the centre or *main axis* of electric action at the line, by which they are separated; and on the other, that it is this latter, or main axis of electric action at the line which, in turn, is the base or ground of projection to its opposite, *magnetic action,*—from which, thus combined as it is with electric,—it diverges on either side to their opposite poles. These forces in this their union, as we perceive, thus mutually *acting on, and re-acting from each other:* as each forms the base or ground either of convergence or divergence to its opposite. And, as being a consequence of the convergence of the electric action of the sun from the opposite extremes of these hemispheres to its centre at the line,—together with the earth's movement of rotation, from west to east, the trade-winds of the tropics are esteemed to be effects; hav-

ing their source, as assumed, in the force of repulsion generated by the latter action. The force of these currents or winds, as connected with the concentric action which induces them, being esteemed to express the sum or measure. The same opposition of forces, attractive and repulsive, being equally generated in the meteors of the superior region of the atmosphere; notwithstanding that, as contrasted with the former, they develope themselves differently: for as it is in the principle of convergence to a centre or axis that these the meteors of the middle and superior region of the atmosphere have their source,—it follows, according to this law of electric and magnetic action, that such convergence or principle of attraction in these meteors, gives birth to, and originates at the same time, an opposite or repulsive action from them to the same amount;—these opposite actions expressing mutually, each the sum of the other.—This brings us to the principle in which the winds or currents connected with the latter class of meteors have their source;—they being, as assumed, contingent on the repulsive force originated by the opposite or concentric action in which, as stated, these meteors have their source. And, as being the counterparts of such concentric action, they are proportionally strong or more violent, as the latter action which originates them is more powerful; and *vice versâ*:—their relations in this respect being esteemed invariable. And as,

when such meteors form on an *electrical ground,* as in summer, and in the lower latitudes, (i. e. when the electric action of the sun in the inferior region of the atmosphere, as contrasted with its opposite, is the dominant action,)—from the action in which they have their source being, in general, more concentric than when under opposite circumstances, as in winter and in the higher latitudes, they form on *a magnetic;*—the first effect of the repulsive force thus created is, usually, to originate the explosive phenomenon of thunder. And of this force, the lightning and thunderbolt may be considered to express the sum, equally as that of the concentric action in the meteor which originates it; and of which storm and hurricane are but different modes of development. These latter, as in winter and in the higher latitudes,—owing to the action in the meteor which induces them being less concentric than in the thunder-cloud, or when it forms on an electrical ground, being the usual manner in which this the repulsive force it engenders develops itself. And which difference in the manner of development of the repulsive force in these meteors, may probably be further owing to the acting and *exciting principle* in the former case, or thunder-cloud, being the inflammable base of the superior region—more particularly connected with magnetic action—*hydrogen:* as in the latter its opposite—*oxygen.* The principle, however, being the same in both; as with-

out the action of convergence in the meteor, to which they are referable, in the first instance, they could not in either case occur :—contingent, as these opposite actions are assumed to be, on the fundamental law of nature so frequently noticed—*the union of opposite progressions of the same kind.*

CHAP. XVI.

Connexion observable between certain Classes of Localities and of Meteors with each other, equally as with the Changes respectively in each of the Meteoric Circles—Annual, Lunar, and Diurnal.—The Aurora Borealis.

But, as the opposite actions of the sun on the atmosphere revolve in *three circles*—the diurnal, the lunar, and annual; and of which, as constituting the ground of meteoric action in the former, it is the action in the latter or annual circle which chiefly determines the effects on the weather induced by the actions in the lunar and diurnal. And that, as noticed in a preceding paragraph,—a fixed and determinate relation always exists between the relative amount of these the opposite actions of the sun in the annual circle and the position of the earth in the ecliptic. Both actions of the sun, as, from after the periods of the equinoxes they converge to their res-

pective main foci in the opposite or summer and winter hemispheres, necessarily increase progressively, as the earth approaches its apsides at the solstices;—when, or rather some time after, from these being the periods of their greatest concentration, these actions as connected with the annual circle, attain their maximum degrees of force on the temperature. To this circumstance, I say, and to the difference which occurs in the relative force of either action of the sun, whether in the summer or winter hemisphere, as it diverges from the site occupied by its main focus, whether at the pole of the latter, or tropic of the former,—it is owing, that in both hemispheres during these the opposite solstial seasons of summer and winter, there are certain *localities* which, from the weather not being disturbed but by the great changes which take place in the annual circle, connected with those of the seasons, may be said more particularly to belong to the latter, or annual circle, viz. those which lie in the vicinity of the main foci of these the opposite actions of the sun. And that, in proportion as we recede to a greater distance from these main foci, whether in descending from the pole of the winter hemisphere, or in ascending from the tropic of the opposite, that the relative force of the existing dominant action of the sun on the atmosphere diminishes, so as that the changes in the lunar circle are sufficiently powerful to induce changes in the wea-

ther,—that thence there is another class of localities in both hemispheres during these seasons, bordering on the former, which is more particularly connected with the lunar circle. And finally, that as in the mountainous districts of these the temperate zones of both hemispheres, and in the vicinity of the sea, where, from the near approach to an equilibrium which, even in winter and summer, exists between the opposite actions of the sun, that the changes in these actions which take place in the diurnal circle of their movement, are at times sufficient to induce changes in the weather. This causes that, similar to the annual and lunar, there is a third class of localities in both hemispheres, which, during summer and winter, may be said more particularly to belong to the diurnal circle, as connected with *the ordinary changes of the weather.* For, as regards those of a different class, or such as have their source in the changes which take place in the annual circle: as the actions in the lunar and diurnal circles are united with those in the former; the periods of their occurrence usually correspond with those when, according to the order of their occurrence in the latter, they should occur;—as being the expression of the conjoint action of all three at the time.

It is further to be observed as not a little curious, that similar to the connexion observed to exist between certain classes of localities and each of the

three circles of meteoric action, as noticed, a like species of connexion appears to subsist between the appearance or occurrence of certain meteors, and the changes which take place in the meteoric action of each of these circles. As, for instance, it is only at the periods of the great changes which take place in the annual circle connected with those of the seasons,—whether at the equinoxes, or during the winter *progression* or *transition* quarters,—that either the larger class of globular meteors make their appearance in the middle or lower latitudes, or the *aurora borealis* in those lying further north. And, of which it may be further observed, that, owing to their being the result of a more powerful action, as that a greater *depth* of the atmosphere is affected thereby than is the case on ordinary occasions,—these meteors are usually the precursors of some of the most violent storms of the year. Thunder and its accessory phenomena, on the contrary, being usually the effects—during spring and summer—of the changes which take place in the lunar action; and with which the changes in the annual circle have no part. Dew and Fog,* as is known,

* *Fog*, or mist, as is known, is the first stage of the meteor in which rain has its source; and *beyond which*, when either of the contributing actions—electric or magnetic—which are esteemed necessary to the production of the rain-cloud, do not concur to the required extent, it does not progress. And as being illustrative that this is the case, it may be observed that though at Lima

being more particularly connected with the changes that take place in the diurnal circle.

But to revert to the *aurora borealis*,—from its being a meteor which, as is known, has long excited the attention of the scientific world; and that, as I conceive, a conclusive proof of the correctness of the principles assumed by our theory is to be derived from it; I have thought it right to notice it in this place. Thus, as refers to the assumed connexion which subsists between the axes of the opposite actions of the sun in the atmosphere, as between those of its meteors and currents, in traversing each other at right angles. And the assumption, that it is on

the occurrence of rain is so unusual; *fog*, or mist, on the contrary, during great part of the year, is of almost daily occurrence. And further, that in the *polar skies* during summer, this the frequency of fog, and absence of rain is likewise observable:—thence, agreeable to this double testimony, we have proved in the clearest manner, the correctness of the principle assumed, in reference to the rain-cloud. As where at one extreme of *the scale* of these actions, in the climate of Lima, magnetic action is so disproportioned to its opposite in reference to the production of rain, we find the meteor in which it has its source, though frequently *commenced*, cannot, in consequence, progress beyond this its first stage:—and that at its opposite extreme in the polar skies, from a similar disparity in electric action, as contrasted with magnetic, the result in this respect is still the same. And, consequently, as refers to the central regions of this meteoric scale,—in either hemisphere, or where these opposite actions in the atmosphere are the most equally blended,—why it is that, in these their temperate zones, the occurrence of rain is the most frequent.

the axis of the weaker or subordinate action of the sun in the middle or superior region of the atmosphere, that *the meteors form* which are induced by the inverse or concentric action of these forces in those regions in which rain and its accessories have their source; as that the direction of the axis of the opposite or dominant action of the sun, is that of the currents in the inferior region which those meteors induce. Under this point of view, esteeming the aurora borealis to be of the same species of meteoric action as that in which thunder and its accessories have their source, i. e. the inverse or concentric action of the electric and magnetic forces in the region where it occurs: but with this difference, that as electricity is esteemed to be the *ground* of the meteor, as stated, in which thunder has its source,—*magnetic* action, on the contrary, is esteemed the base of the meteor in which the aurora has its source; i. e. *that,* in the conjoint action of the electric and magnetic forces which has the preponderance. And as this, according to the principles assumed would, if correct, cause that the axis of the aurora should traverse the line described by the magnetic meridian; we shall find that in every instance of its appearance *such is the case.* The angle which the axis of the aurora forms with the magnetic meridian—varying with the distance from the pole—being more completely *a travers* or at right angles with it in the higher latitudes; and, si-

milar to the currents, deviating more or less from this as it approaches farther south:—the storms which succeed, as should be the case, taking an opposite direction. It may be further observed of the aurora, that, esteeming its coruscations to be of the same nature as the lightnings projected from the thunder-cloud,—and that the direction of the latter is to the earth, or inferior region of the atmosphere, where, at the time, electricity is still in an *idio-electric* state: and which direction of lightning to the inferior region, is probably an effect of the electric attraction which, as is known, exists between bodies in opposite states of electricity. Thus, as magnetism is assumed to be the predominant action in the production of the aurora; and that the lightning or corruscations it projects, instead of taking the direction of the earth, ascend in the opposite, or to the zenith:—may not the cause of this be that, as the base or ground of the meteor which originates the aurora is *magnetic*, and that, as in the instance of the thunder-cloud,—as magnetism exists in the superior region of the atmosphere above it, similar to electricity, in the latter case, in the inferior region, in what may be denominated an *idio-magnetic*, or different state from what it does in the meteor beneath; that this the direction of the corruscations of the aurora may not be an effect of the attraction which, as in the former case, may exist between bodies in opposite states of magnetism?

CHAP. XVII.

Further Proof of Principles, in reference to the assumed Influence of Magnetic Action, derived from the sudden and total Change of the Seasons at the Periods of the Equinoxes, on the opposite Sides of the Peninsula of India.

And, as being esteemed further illustrative of the important influence exercised by magnetic action in particular localities on the seasons and weather,—assuming it to be the cause:—in addition to the instance noticed in the climate of Lima, may be cited the total change from summer to winter, or from drought to rain, which at the periods of the equinoxes takes place on the opposite shores of the Peninsula of India, separated as they are by the lofty chain of mountains which traverses its centre, i. e. those of Malabar and Coromandel. A change so sudden and remarkable as to have not only attracted the attention, but excited the astonishment of naturalists; and of which the following account, copied from the first volume of Raynal's celebrated work on the Commerce of both the Indies, may serve to convey an idea: "L'Indostan n'est que le pays renfermé entre l'Indus et le Gange, deux fleuves célèbres qui vont se jetter dans les mers

des Indes, à quatre cents lieues l'un de l'autre. Ce long espace est traversé du Nord au midi, par une chaîne de hautes montagnes, qui, le coupant par le milieu, va se terminer au Cap Camorin, en séparant la côte de Malabar de celle de Coromandel.

" Par une singularite frappante, et peut-être unique, *cette chaine est une barrière que la nature semble avoir élevée entre les saisons opposés.* La seule *épaisseur* de ces montagnes y sépare l'été de l'hiver; c'est-a-dire: la saison des beaux jours de celle de pluies: car on sait qu'il n'y a point d'hiver entre les Tropiques. Mais par ce mot, on entend aux Indes le tems de l'année où les nuages, que le soleil pompe au sein de la mer, sont poussés violemment par les vents contre les montagnes, s'y brisent et se résolvent en pluies, accompagnées de fréquens orages. De-là se forment des torrens qui se précipitent, grossisent les rivières, inondent les plaines. Tout nage alors dans les tènèbres humides, épaisses et profondes. Le jour même est obscurci des plus noires vapeurs." * " L'été, sans doute, conserve mieux son caractère que l'hiver dans cette région du soleil. Le ciel sans aucun nuage qui intercepte ses rayons, y présente l'aspect d'un airain embrasé." * " L'influence des deux saisons est encore plus marquée sur les deux mers de l'Inde, où on les distingue sous le nom de moussons sèches et pluvieuse. Tandis que le soleil, revenant sur ses pas, amêne au printems la saison des tempêtes et

des naufrages pour la mer qui baigne la côte de Malabar, celle de Coromandel voit les plus légers vaisseaux voguer sans aucun risque, sur un mer tranquille, où les pilotes n'ont besoin ni de science, ni de précaution. Mais *l'automne*, à son tour, changeant la face des élémens, *fait passer le calme sur la côte Occidentale, et les orages sur la mer orientale des Indes;* transporte la paix où étoit la guerre, et la guerre ou étoit la paix. L'insulaire de Ceylon, les yeux tournés vers la région de l'Equateur, aux deux saisons *de l'Equinox,* voit alternativement les flots tourmentés à sa droite et paisable à sa gauche; comme si l'auteur de la nature tournoit tout-à-coup, *en ces deux momens d'équilibre,* la balance des fléaux et des bienfaits qu'il tient perpétuellement en ses mains. Peut-être même est-ce dans l'Inde, où les deux empires *du bien* et *du mal* semblent *n'être séparé que par un rampart de montagnes,* qu'est né le dogme *des deux principes,* dogme donc l'homme ne s'affranchira peut-être jamais entièrement, tant qu'on ignorera les vues profondes de l'être tout-puissant qui créa l'univers." *Histoires Philosophiques*, tome 1, pag. 55 et suiv.

When, even in the comparatively enlightened times in which we live, the rank weeds of superstition still flourish, and continue to extend their baleful influence over so large a portion of society; it is not to be wondered at if, during the protracted night of "cimmerian darkness" which so long

hung over the human mind, and paralysed its energies; the extraordinary spectacle presented by the sudden revolution of the seasons in regions of the atmosphere so proximate as are those at the opposite sides of the peninsula of India at the periods of the equinoxes, should, from the profound impression it was so well calculated to make on the sensitive temperament of its inhabitants,—have as conjectured by Raynal, first suggested the idea of personifying the opposite principles of *good* and *evil;* and which thence diverging, probably extended to Egypt, and other countries of the East, has served as the basis of the various systems of theology which, during so many ages, have continued to distract, disgrace, and bewilder so large a portion of the human race. Thus, as in other cases, showing the intimate connexion which has always existed between the moral and physical world; and the powerful influence exercised by external nature on the opinions, the habits, and institutions, both civil and religious of mankind. For, it were vain to seek elsewhere for such striking proofs of the influence exercised by the principles which preside over and determine the variations of the temperature, and other phenomena of the seasons, as those induced by the equinoxes on the shores of the peninsula of India. And it will serve to place in a true light all that had to be done, in order to arrive at the cause of these extraordinary changes, when even so en-

CHAP. XVIII.

Tendence of Meteoric Action in the Atmosphere, as connected with the Annual and Lunar Circle.

But the latter is not the only point of view in which these changes of the seasons at the extremity of Hindoostan claim our attention; as by them we are likewise supplied with the most unerring data in reference to one of the most difficult and important departments of meteorology, viz. those which influence and determine the *tendencies* either to drought or humidity, whether as connected with the annual or lunar circle of meteoric action. Which, it may be added, are of a nature such, as, throughout the year, and in every latitude and species of locality, exercise so marked an influence on the seasons and weather, that without some acquaintance with these the principles to which they are referable,—calculation in regard to expected changes in the weather, would still continue to be, as heretofore, both doubtful and imperfect. And as from the actions in the annual circle being the ground of the actions in the lunar and diurnal, they are those which throughout the year exercise the greatest influence on the seasons and weather; the circumstances which determine the changes in these tendencies in the latter,

are those necessarily which first claim our attention. And as the operation of the causes connected with these changes in the annual circle are sooner felt, and more strongly marked in the weather, in the vicinity of the sites occupied by the main foci of the opposite actions of the sun, in the lower latitudes, and polar regions, than in those which lie between: this brings us to a re-consideration of the principles, under the present point of view, connected with the sudden changes which, at the periods of the equinoxes, take place in the seasons, on the opposite shores of Malabar and Coromandel. These changes, as we perceive, instead of advancing, as elsewhere, by slow and, as it were, imperceptible degrees; being, as described, both sudden and entire. And assuming the cause of these changes, as stated, to consist in the transition which at the equinoxes takes place in the magnetic action of the sun from the pole of the approaching summer, to that of the approaching winter hemisphere of the earth;—the first circumstance to notice, as connected with them is, that *the extremes of the lever*, to the alternate changes in the action of which they are referable, are not confined to either, but extend to the extremities of these the opposite hemispheres: this lever being no other than the line or meridian which connects their opposite magnetic poles. And which, as the main force or amount of the magnetic action of the sun at each succeeding equinox, becomes alter-

nately transferred from one to the other of these poles,—of the sudden revolution in the direction of magnetic action throughout the body of the atmosphere, consequent thereon, the violent phenomena which, from these the periods of their occurrence, are called the *equinoctial gales*, are to be esteemed the first effects; and which subsequently, or after the equilibrium of magnetic action is anew restored in the direction thus given to it;—and that, with the advance of the season, its force increases in the vicinity of the pole:—as this action continues to weigh on, and sink the temperature in the winter hemisphere, it serves, by its gradual diminution in the opposite, to elevate it in the latter to the same extent. And thus, as from after the autumnal equinox we approach the period of the winter solstice—as being connected with the gradual fall of its temperature, the increasing force of magnetic action in the winter hemisphere, induces a continual tendence in the weather during this period of the year to *rain:* as, owing to the operation of a totally different principle, viz. the consecutive increase of electric action,—the tendence of the weather in the opposite or summer hemisphere during the same interval, is to *drought.* This necessarily causes that, similar to the seasons, the tendence of meteoric action in the opposite hemispheres of the earth, from the equinoxes to the solstices is constantly contrasted; and that, by means of these the changes of position alter-

nately in the magnetic, equally as in the electric action of the sun at the periods of the equinoxes, both at the poles and tropics,—similar to the opposite strokes of the steam-engine connected with its movement of rotation, it is, that the annual revolution of the seasons and weather in both hemispheres, is upheld and perpetuated.

And, as from the union of the electrical and magnetic forces in the atmosphere, there must of necessity exist in its body *a common centre,* to and from which, with the changes of the seasons, they converge and diverge to their opposite main foci in the opposite hemispheres; and which as being the true limit of meteoric action in either, can be no other, as already noticed, than the *magnetic equator* by which they are separated. It is easy to see that in these the periodical changes which, at the equinoxes take place in the sites of the main foci of these forces from either hemisphere to the opposite, that as the point of their *horizontal collision* at these periods, must be *on the line* of the magnetic equator, that it is on, or in the vicinity of the latter they should first induce those changes in the seasons and weather, incident thereto. And this will serve to show why, as proved by the fact, that, owing to the position and local influence exercised by the chain of mountains which separates the opposite sides of the peninsula of India, it is here where these periodical changes in the opposite actions of the sun first pro-

duce their effects on the seasons and weather. And that, as the magnetic equator, or axis of magnetic action, is situated at, or in the vicinity of the line, and is, in those regions, consequently, *the weaker action* of the sun; conformable to the law in reference to the concentric action of these forces in the atmosphere already stated, viz. that the meteoric action incident thereto always forms on the line described by the axis of the weaker force. Thus, that changes in the weather at the periods of the equinoxes should, in the first instance, as they commence at the junction of the opposite hemispheres, be in their direction *east and west.* And that as, with the advance of the season, the magnetic action of the sun increased in the winter, as its electric in the opposite or summer hemisphere of the earth; their effects of inducing an increased tendence to rain in the former, as to drought in the latter, should gradually develop themselves further, in the direction of the poles; till, about the periods of the solstices these opposite tendencies on either hand, would have attained their maximum degree, and greatest extension throughout the various regions of both. These the opposite actions of the sun, with the opposite tendencies in the weather which they induce, similar to two waves diverging from a common centre in opposite directions, thus, at the periods of the equinoxes, diverging from the line described by the magnetic equator; and, with the ad-

vance of the seasons, gradually extending their effects over both hemispheres, thence to the opposite poles. But, as the magnetic action of the sun in the winter hemisphere, though at first it induces rain, ultimately, or as soon as, whether at, or subsequent to the winter solstice, it causes the temperature to fall below the freezing point,—(similar to its electric action in the opposite,)—induces a change of tendency in the weather to drought. And further, that the contrast in the weather of the opposite hemispheres induced by these the opposite actions of the sun, is much greater as connected with its opposite states of *drought* and *humidity*, than with the rise or fall of the temperature; as proved by the contrasts in the lower latitudes at the periods of the equinoxes so frequently alluded to. This causes, that, when at, or subsequent to the solstice in the winter hemisphere, and owing to the great fall of the temperature, the tendence in its atmosphere is to *drought*; that it has the effect, at this period, of inducing an *opposite tendency* in the atmosphere of the summer hemisphere.

And as, of the three conditions which chiefly determine the relative force of the opposite actions of the sun on the atmosphere, viz. *distance*, *magnitude*, and *length of exposition*:—the first, as connected with the proximity of places to the main focus of its electric action at the line, and the latter, or greater length of exposition to the solar action,

owing to the greater length of the day;—induces a more powerful development of this the electric action of the sun during summer, in the higher and lower latitudes of either hemisphere, than in those which lie between. This causes that, as the relative force of the solar action in the summer hemisphere about the period of the solstice, is much less in its central latitudes, or *temperate zone*, than in those on either side;—the change in the tendence of meteoric action in the regions of the latter, at this period, is much more apparent, and sensibly felt in the weather than in the polar or tropical skies. And that, in tracing as to their source the rains which about the period of the summer solstice usually set in with us, and continue thence to about the middle of July, or period of *greatest cold* in the southern hemisphere;—to this the change of tendence to drought, in the latter, incident to the annual fall of its temperature during this period,—the change of meteoric tendence with us, and the rains it induces, are to be ascribed. About the period of *St. Swithin*, however, if the calorific action of the sun be sufficiently powerful, the tendence of meteoric action again undergoes a change with us to drought; which continues till interrupted by the setting in of the autumnal equinox. But, owing to the usual weakness of the solar action with us at this period of the year, the latter change in the weather at *St. Swithin* but rarely occurs; and thence it generally happens

that the tendence to rain which sets in about the solstice, continues, with little interruption, to the autumnal equinox.

But, to revert to principles :—it may be stated as a general rule, that, whether in summer or winter, in tracing as to its source the existing tendence in the weather, whether to rain or drought,—it will be found in the tendence of an opposite kind, which at the time exists in the opposite or southern hemisphere of the earth. Thus showing the intimate connexion which subsists between meteoric action in the most distant regions of the atmosphere, however seemingly remote; and the necessity which occurs of grappling with the ensemble of this action in the atmosphere of both hemispheres, in order to arrive at a knowledge of the principles by which it is determined.

Thus, as refers to the annual circle:—the tendence of meteoric action from the autumnal equinox to the winter solstice, is *to rain:* being an effect of the share magnetic action at all times has in its formation;—its increase during this period being consecutive; and which, acting on an opposite or *electrical ground* in the inferior region of the atmosphere, necessarily induces this effect. To this, if the temperature sinks below the freezing point, and continues so during some time; an interval of *drought* succeeds, till the period of the extreme degree of winter cold; or about a month after the solstice.

Thence, till after the period of the vernal equinox and the phenomena connected with it, the tendence of the weather is *to rain*, being an effect of the transition in the temperature consequent on the increase of the electric action of the sun, acting on a *magnetic base* in the inferior region of the atmosphere, while yet the latter is the dominant action of the sun. From after the autumnal equinox to the period of the summer solstice, the tendence of the weather is again *to drought*, being an effect of the domination and consecutive increase during this period of the electric action of the sun. And, finally, (owing to the fall of temperature and opposite tendency consequent thereon in the winter hemisphere,) the tendence of the weather from the period of the summer solstice till after the extreme degree of summer heat about a month subsequently, is *to rain*; but more generally, as stated, to the period of the autumnal equinox.—The scale of variation in the weather of the seasons, as here sketched, is chiefly such as occurs in our skies, or the temperate zones of both hemispheres; as matters in this respect are very different, both in the vicinity of the poles and tropics. And thus it will be seen that the meteoric division of the annual circle or year, varies with the season, the latitude, and the nature of the locality.

But as the variations connected with latitude and locality, however extensive and influential, are,

from being better known, subordinate in interest to those connected with the changes that take place in the seasons of different years: the latter more particularly claim our attention in this place. And, as these changes do not fall equally *on the different quarters of the year*, it will be necessary, in the first place, to point out the natural division of the annual circle as connected with these variations. Thus, the equinoxes and solstices, being the opposite cardinal points of the annual circle; its first division,—as laid down in the diagram of the annual circle, which will be found in the subjoined paper on the lunar action on the weather,—is, according to the lines which connect them. And as, from the extreme degree of summer heat, as of winter cold, being each an effect of the extreme concentration of the existing dominant action of the sun by which it is induced, it necessarily *falls after* the period of the solstice; and that the changes which occur in the seasons of different years depend on those of the temperature. Thus, in addition to the lines which connect the cardinal points of the annual circle, it became necessary to add a third, to connect the points at which, subsequent to the solstices, these the opposite extreme degrees of annual temperature are supposed to occur; and which, together with the latter, express *the line of greatest variation* in the opposite actions of the sun. And, as contrasted with the latter, or line of greatest variation, it be-

came equally necessary to introduce another, or fourth line, traversing the latter, or line of greatest variation, and terminating on the opposite sides of that of the solstices, about equidistant from the latter points on the one side, as the line of greatest variation on the other, as being that of *permanent uniformity* in the opposite actions of the sun; i. e. that of the opposite points of the annual circle preceding the solstices, where *the least variation* occurs in the solar action. The necessity which existed for the introduction of this latter division into the meteoric chart of the year, will appear from the circumstance that, as the lunar action on the weather is always determined both in its nature and effects by the *meteoric ground* in the annual circle on which it acts; and that, with the exception of this the line of uniformity, the solar action is so variable in its other divisions, that, without its existence, in order to substantiate by a uniformity of effects on the weather produced at these periods of the year by it, the *lunar action*, it were impossible to afford such proofs of the latter, as the nature of the subject required, and which, by carrying conviction in their course, would satisfy the most sceptical as to its existence, equally as to its nature and extent. And as in regard to certain points connected with physics, it is only by analogy we are enabled to speak with certainty; did there not exist proofs of a nature so conclusive, in reference to the existence and

extent of the lunar action on the weather, as those afforded at the opposite periods of the year alluded to; and that in the absence of them we were deprived of every thing like *certainty*, in regard to the existence of a *planetary* or *cometary* influence on the temperature and weather of the seasons; it is easy to see the irreparable loss to this the first of sciences—meteorology—which would thence ensue. By means of the proofs afforded at these periods of the year, however, in reference to the existence and nature of the lunar action on the temperature and weather;—from the analogy being perfect—we are thus, for the first time, enabled to speak with certainty on this important subject. And further, to trace as to their primary cause the source of those variations observable in the temperature and weather of the seasons of different years, viz. to the changes which take place, whether in planetary or cometary influence, arising from the changes which, similar to those of the moon, are continually taking place in the position of these bodies in reference to the sun and earth. And as in nature all is simple, because all is perfect; thus it is that her principles of action being once ascertained, every thing like difficulty disappears, in reference to tracing her phenomena through their different bearings and relations.

CHAP. XIX.

The Variations in the Temperature and Seasons of different Years, esteemed to be Effects produced by the Changes which take place in the meteoric Action of the external Planets, as of Comets, on our Atmosphere.

THUS, the fundamental principle on which the whole of the dispositions of nature in the physical world are founded, being, as assumed, that of *unity*, and which, as refers to astronomy and meteorology, implies the existence of a connexion between the different members of the solar system, however divided or distant one from the other: and which, if so, could only exist or be upheld by means of a bond such, as from being applicable to all, at the same time embraced within the sphere of its operation the entire of their superficies. Thus it is that *reflective action* between the sun and planets, as being that only which answers to these conditions, is esteemed to be, as noticed, the principle of this connexion, and the *first cause* in physics; it being, as assumed, the vehicle by means whereof the collective action of the electrical and magnetic forces, distributed throughout these bodies, is conveyed to each; varying in reference to the action of either

force on their seasons, with the variation in the relative position of these bodies to each other, and to the sun. The sum of this reflective action, in every instance, being greatest when these bodies are in their *syzygies*, as proved by the tides at the periods of the equinoxes, and lunar syzygies; and its effects on the temperature being greatest as they approach the periods of their *quadratures;* as shewn by the earth at the solstices. The action of these the superior and inferior planets, as of comets, similar to that of the moon, is, as already stated, esteemed to be *positive* or electrical at and subsequent to the periods of their syzyges; and *negative* or magnetic at and subsequent to those of their quadratures: and, as being a consequence, that they have the effect of rising the temperature of our seasons at the former, as of lowering it at the latter periods. And as the forces of nature in the solar system cannot be supposed to undergo either increase or diminution; and that it is only by a *homogeneous* principle or action that variations in the temperature and other phenomena of the seasons could be induced; where, I would ask, are we to look for the source of these variations, if not in the changes which, with those of their positions, take place in the meteoric action of these bodies, as assumed? For as, according to the principle of reflective action, as understood by our theory, nothing connected with the planetary world can be *neuter;* but, on the contrary, that the

forces electrical and magnetic, connected with each of the bodies which compose its members, are always, as regards the others, in a state of activity; it will follow, admitting the change in the nature of the meteoric action of these bodies on each other, with that of their positions,—that the same body must, according to its position, whether by increasing the sum of electric or magnetic action in our atmosphere, have the effect, at one period of adding to, and at another of detracting from, the temperature of our seasons. Which, as regards comets, will serve to account for the contradictory statements we have, in regard to the seasons on which they have appeared; increased heat, earthquakes, &c. being attributed to some, and increased cold, excessive rains, &c. to others; of which the following statement, copied from the *Observer* Dublin paper, of the 17th October, 1835, will serve to convey an idea, viz. "*Portents of Comets.*—In 1005, the appearance of the comet was attended by a great famine, (probably induced by excessive heat;) "in 1080, by an earthquake; in 1155, by a cold winter and a failure of crops; in 1230, by rains and inundations, (part of Friesland was overwhelmed, with 100,000 inhabitants;) in 1304, by great drought, and intense cold in the following winter, succeeded by a pestilence. In 1310, by a still more destructive contagion. In 1456, by wet weather, inundations, and earthquakes; again, in 1531, by

great floods; in 1607, by extreme drought, followed by a most severe winter. In 1682, by floods and earthquakes. In 1759, by some wet, and slight earthquakes. Those of 1795, 1807, and 1811, by extreme hot and unhealthy weather; as the present portentous one, foretold by Dr. Edmund Halley, hence called "Halley's Comet." If, as I am disposed to do, we admit the existence of cometary influence on the temperature and seasons, these statements, as will be seen, can be only reconciled on the principles assumed. And, in reference to comets, equally as the superior and inferior planets, I esteem this agency to be more influential in proportion to their greater *magnitude* and *vice versâ*, the circumstance of *distance* being the same; and consequently, as regards the latter bodies, that Jupiter, Saturn, and the Uranus, are those which exercise the greatest influence on the temperature and other phenomena of our seasons. And if I may be allowed to produce some recent instances in proof of the existence and extent of cometary and planetary influence on the seasons;—sufficiently striking illustrations appear to be furnished by the uninterrupted mildness of the winters, and heat of the summers since 1830; when, as will be recollected, it was announced in the almanacs, that the whole of the superior planets were in *opposition*, or at the periods of their syzyges, including the appearance of Halley's comet in 1835. A mildness of the winters, it

may be observed, not peculiar to the countries of the middle and lower latitudes; as a gentleman from St. Petersburg assured me, that during this interval, *rain* has been known sometimes to occur there about Christmas; a circumstance almost unprecedented, he added, in that northern region, at so late a period of the year.

CHAP. XX.

Lunar Action on the Weather.—Connexion of Magnetic Action with the Principle of planetary Cold, proved by the Relation which subsists between the relative Mildness or Severity of the Winter in either Hemisphere, with the relative Drought or Humidity of the Summer in the Opposite.

Having thus, by means of the proofs derived from the lunar action on the weather, been enabled to speak with certainty of the existence and nature of planetary and cometary influence on the seasons. Though in the succeeding Part, but little connected with the subject of the lunar action is omitted; yet I esteem the following short observations as not uncalled-for in this place.

It being, as noticed, the changes connected with the weaker action of the sun, both in winter and

summer, which cause changes in the weather to rain; thus it is, considered as a general rule, that it is the lunar action which at the time is in contrast with the existing dominant action of the sun in the annual circle, which, according to the order of its occurrence, as connected with the lunar action, induces such changes: this order being occasionally changed, owing to the influence on the weather exercised, where it occurs, by local causes. And thence, as proved by the fact, it is the positive lunar tides, or those at the syzyges, in winter; and the negative lunar tides, or those of the quadratures, in summer; which usually induce the occurrence of rain and its accessory phenomena. This being more particularly the case from the equinoxes to the solstices, or periods of the year when, as stated, the least variation in the opposite actions of the sun on the opposite hemispheres takes place. From this it follows, as a general rule, that *the same action* of the moon, induces directly opposite effects on the weather in the opposite or summer and winter hemispheres of the earth. And as in contrasting the winter, and summer *progression quarters*, or those which extend from the equinoxes to the solstices; the effects of the lunar action on the weather are more strongly marked, or conspicuous, in the former, than in the latter season, because of their connexion with storm, &c. Thus, on the principle of *contrast*, noticed, consequent on the same action of the moon,

in the weather of the opposite hemispheres,—the surest guide for calculating in advance the approaching changes of the weather with us during the months of April, May, and early part of June, is that supplied by the contrast in the weather, at the time, produced by the lunar action in the opposite or winter hemisphere. For as the lunar action at the syzyges, during these months, is sure to induce storm and rain in the southern hemisphere; thus it is that these periods of the moon with us are usually accompanied by fair weather and a marked rise of temperature. And, on the other hand, as the second quadrature of the moon with us in December immediately preceding the period of the winter solstice, usually brings with it the first *frost*, or fall of temperature below the freezing point, accompanied, necessarily, by drought and fair weather; and that the same period of the moon, in the month of June preceding the solstice, may be supposed to produce the same fall of temperature in the atmosphere of the southern hemisphere, and return to fair weather. To this, as to its true cause, may, probably, be ascribed the period of *storm*, which at, and subsequent to the second quadrature of the moon, in the early part of June, usually occurs in our skies: so intimate being the connexion which subsists between the extremes of this most potent, though *unsubstantial* lever, however distant; as it

ascends or descends in the atmosphere of either hemisphere, on the phenomena of the opposite.

But as, to the uniformity in the opposite actions of the sun during these the summer and winter *progression quarters* is chiefly to be ascribed the uniformity in the effects of the lunar action on the weather; and that at and after the periods of the solstices this uniformity in the solar actions no longer exists; but gives place to the periods of their greatest variation, which immediately follow: and that, as in other cases, corresponding changes in the effects consequent on these variations must result therefrom. Thus it is, in reference to the lunar action immediately after, as contrasted with the periods which precede the solstices. For, owing to those variations in the relative amount of the opposite actions of the sun, combined with the change which with that of the actions in the diurnal circle takes place in the length of the day and night immediately after the solstices. To the periods of greatest regularity in the effects of the lunar action, succeed during these the summer and winter *transition quarters*, (i. e. from the solstices to the equinoxes,) those of the greatest irregularity in the effects of the lunar action on the weather. Notwithstanding, however, that during these seasons the lunar action can no longer, as before, answer, with any degree of certainty, the purposes of calculation; it does not follow but that we are still supplied

with an equally sure guide to the approaching changes of the weather. For, as these are the periods of the year when the opposite actions of the sun in the annual circle, exercise the greatest influence, (because in some measure detached from those of the moon,) on the temperature and weather; by means of the *contrast*, (even more strongly marked during these, than in the progression quarters by which they are preceded,) in the effects induced by the opposite actions of the sun on the weather of the opposite hemispheres,—this defect in the lunar action is compensated for. Thus, as in the winter hemisphere, the first tendence in the weather immediately after the solstice, is to frost and *drought*; the first tendence in the opposite or summer hemisphere, after the solstice, is to *rain*: and the more decided the tendence to drought in the former, the more decided is the opposite tendence in the weather of the latter; and *vice versâ*. And thence it follows that, from the state of the weather after the solstice, in either hemisphere, we are enabled to know with every degree of certainty, the nature of the season, and state of the weather at the time in the opposite. Slight rains with us, for instance, after the summer solstice, being indicative of *much rain*, and *a mild winter* in the southern hemisphere; and *vice versâ*.

And these facts, it may be added, are the more important, when it is considered that these opposite

states of the weather in the opposite hemispheres of the earth, after the solstices on such years, (*i. e.* on mild winters and hot summers,—being, as they are assumed to be, effects of the *diminution of magnetic action* in the annual circle at the time: as *drought and intense cold,* in the winter hemisphere, simultaneously with heavy rains, in the opposite, are, in like manner, indicative of *increased force* in the magnetic action of the sun, in the annual circle, on the seasons they occur,) go to show, in the clearest way, that a direct connexion exists between magnetic action and *the temperature,* or phenomenon of winter cold; equally as between it and that of *rain.* For, assuming this to be the case, the connexion between the relative degree of *winter cold* in the one hemisphere, with that of the relative amount of rain at the time in the opposite, becomes equally clear and undoubted, as between magnetic action, and the relative humidity or drought of the climate of particular regions,—agreeable to the greater or less amount of their exposure to the action of the proximate magnetic pole of the earth, as already noticed.

And as, after about the interval of a month from the solstice, in the winter hemisphere, or period of greatest cold, the tendence in the weather changes from drought to humidity, which continues till the vernal equinox: in the same proportion as this tendence to rain in the winter hemisphere becomes

more decided; the tendence of the weather in the opposite or summer hemisphere after the solstice, changes from rain to drought, as we approach the period of the autumnal equinox. And thus, the principle of contrast, as connected with meteoric action in the atmosphere of the opposite hemisphere, considered as a principle of calculation, is, from the superior force and influence of the actions in the annual, than in the lunar circle, still less liable to error in the former than in the latter.

But *distance*, as already noticed, being one of the conditions which determines the amount, or relative force of the solar action on the planets, both in their individual and collective relations. And that as, with the change in the position of the moon in reference to the sun and earth, that when *in conjunction*, or at the change, as contrasted with her position when in *opposition* or at full moon, a difference thus occurs between the relative force of the meteoric action of the moon on the atmosphere, as connected with the opposite sides of her orbit. Thus it is, though the actions are of the *same name*, that, throughout the year, a difference sufficiently marked exists between the effects on the weather equally as on the tides induced by the lunar actions both positive and negative, from the period of the *first quadrature, to that of the second*, as contrasted with her actions from the latter to the former:—both her negative action after the period of the se-

cond quadrature, as her positive action at, and subsequent to the change, being more powerful and influential on the temperature and weather, than what these her opposite actions are, after the first quadrature, and period of full moon, other circumstances being the same. And as effects necessarily vary with their causes; thence, as assumed, the source of the difference observable in the lunar action on the weather, as of the *tendence* of meteoric action throughout the year, on the opposite sides of the lunar circle, as divided by the line of the apsides; as will be found more fully noticed in the second part.

And that, from after the antumnal, to the vernal equinox, or period of the domination of the magnetic action of the sun in the annual circle, from its being the more powerful electric action of the moon, and consequently *that* which at the time contrasts most with this the magnetic ground of meteoric action in the annual circle; that together with the vernal equinoctial phenomena, the most violent storms and rain—but particularly from the autumnal equinox to the soltice—more frequently occur at, or preceding the period of *new*, than of full moon. And on the contrary, that during the opposite division of the year, or while the electric action of the sun is the dominant action in the annual circle; as the electric action of the moon is *less*, and its magnetic action *more* powerful, from the period of full moon,

to the conclusion of the negative tide of the second quadrature, than when in the opposite division of its orbit, and thus that it contrasts more with the electric ground in the annual circle; that, not only the equinoctial phenomena in autumn, but the most violent storms and rain during this the summer division of the year, usually occur at the period of full moon, or subsequent to the second quadrature. The sole exceptions to this rule whether in summer or winter being in regard to the moons which immediately succeed the periods of the solstices; when for the moment, owing to the sudden change of meteoric tendence in the annual circle, the effects of the lunar action on the weather, as described, appear to be reversed.

But, as entering further on the subject of the lunar action on the weather in this place, were to anticipate too much what will be found respecting it, in the subjoined part, alluded to; I shall only add that, as throughout the year, for the reason already stated, the lunar syzygies are *minor equinoctial periods;** as its quadratures, minor *solstial periods*, from their being those at which, (as in the annual circle,) the greatest concentration of the preceding

* Owing to the change of tendence *from drought to rain*, which takes place in the annual circle from the summer to the winter solstice; it is during this part of the year chiefly that the effect of the lunar syzygies in inducing storm, is the most conspicuous.

action of the moon on the temperature takes place. Thence it is that both the equinoctial phenomena in spring and autumn, equally as the other more violent storms of the year, are usually connected with the former; as the extreme degrees, equally as the sudden change in the temperature, with the latter periods of the moon. And thus, as refers to the present theory, it is assumed, that, even in the absence of all other proofs of its correctness, those supplied by the lunar action on the weather, (as should be the case if correct,) will be found so numerous and palpable, as must shortly insure to it public confidence; by satisfying all persons whose minds are not closed to conviction, of its truth.

CHAP. XXI.

Distinctness of Meteoric Effects in the Atmosphere as connected with each of the local Circles.—Diurnal, Lunar, and Annual.—Phenomena of the Tides.—Assumed Relations, in regard to the Influence on our Seasons exercised by the superior Planets.—Sun's Movement of Rotation, and Solar Light.—Conclusion.

It is further observable of meteoric action in the atmosphere, connected at once, as it is, with the

three local circles, diurnal, lunar, and annual; that though the forces in these circles are homogeneous and act simultaneously, the action in each is perfectly distinguishable from that progressing in the others, in the phenomena it induces, not alone in the temperature and weather, but even in those of *the tides:* as if to remove all doubt as to the meteoric source of the latter.

Thus, on the principle, now so generally accredited, "that the earth and its atmosphere form a thermo-electric combination put into action by the sun;" and that the centre, or point of horizontal *divergence* of its magnetic currents, and *convergence* of its electric, is as noticed, the *magnetic equator* situated between the tro ics.

To the force of the electrical currents collected by the solar action from the extremes of the opposite hemispheres on either side, on this the magnetic equator, in the *diurnal circle*, is, in the first place, as stated, to be ascribed the earth's movement of rotation; as to the force of impulsion inseparable therefrom, acting on the mass of its waters, is, in the second, as to their primary source, to be ascribed the phenomena of the tides. And as the length of the day between tne tropics is invariable; and that the impulsion thus originated by the solar action, in commencing at sunrise, or six o'clock, goes on gradually increasing with this action till the sun has reached the zenith at noon, when it is greatest; and

thence as he descends to the west, and that this his reflective force decreases, that with that of the latter the force of impulsion it originates decreases, till it finally expires at sunset, or six o'clock in the afternoon.

Thus, as connected with the tides, the wave it originates in the waters of the ocean, at the period of its setting in in the morning, and which growing with its growth, has attained its greatest elevation at noon, or period of high water; thence, with the descent of the sun to the horizon, and consequent falling off in the force of the impulsion it induces, the latter gradually decreases on the mass of the waters, till, with the disappearance of the sun below the horizon, having totally expired, this the wave or tide it originated in the morning, has returned to the same plain or low-water mark, from which it originally sprung;—such being the view of these phenomena assumed by the present theory. The tide by which this solar tide by day, is succeeded at night, being esteemed simply the effect of *rebound;* and which, from the continual progression of the opposite or solar wave on the opposite side of the earth at the time; and thence that the whole of its circumference is equally divided between these opposite waves; thus the *night* wave is regulated in the period of its rise and fall during the absence of the sun, the same as that by which it was induced and preceded during the day. And in comparing the interval during which these opposite or

solar and nocturnal tides take, to perform one entire revolution, with that of the circle to the action in which they are ascribed; we find that the former exceeds the latter by no more than the difference which exists between the length of *the lunar*, as contrasted with the solar day; or period at which the moon crosses the same meridian during two days consecutively; and which, it is not denied, shows a direct connexion with the lunar action; but, as regards the diurnal circle of meteoric action, only to the extent, that the reflective action of the moon serves as the *pendulum* by which the more powerful action of the sun in the latter, or diurnal circle, is regulated. This difference, moreover, being no more than, considering the mass of waters acted on, were absolutely necessary, between the expiration of either movement, and the incipient operation of the opposite by which it is succeeded. Such, as assumed, being the source of the tides; and the manner in which they are connected with the meteoric action of the sun and moon in the *diurnal* circle. The progression of the tide-waves, north and south, through the opposite hemispheres of the earth, from the centre of impulsion at the line, being a necessary effect of the laws which determine and regulate the movements of fluids. And the difference which, as is known, exists in the height of the opposite tides in the diurnal circle, may be cited as further corroborative of the fact,

that the second, or nocturnal tide, is simply an effect of re-bound; as the falling off which occurs in the latter with the absence of the impelling force, is quite visible; and can be only accounted for in this way.

In reference to the connexion of the tides with the *lunar circle* of meteoric action, it requires nothing in the way of argument to prove; from this connexion (owing to the coincidence which exists between the periods of the spring and neap tides, with those of the lunar syzygies and quadratures,) being universally admitted to exist; though the principle in which it is assumed to consist is different. But though, as noticed, acting simultaneously with the action in the diurnal circle, this the connexion of the tides with the lunar circle, is perfectly distinguishable from the connexion of these phenomena with the former or diurnal circle, as alluded to; and this, notwithstanding that the analogy between the actions in both circles is perfect. For, though the interval occupied by each revolution of the spring and neap tides extends to one half the lunar circle, as that of each revolution in the diurnal tides, does to half the latter circle; yet, though subdivided into twenty-eight of the diurnal tides, each revolution of the former can be considered no more than the effect of the gradual increase and decline of a similar or homogeneous action in the lunar, as in the diurnal circle. A similar difference

as between the opposite tides in the diurnal circle, though originating in quite a different cause, being equally observable between the height of the spring tides at the opposite periods of new and full moon. The source of this difference, as that already noticed in its connexion with the weather, being, as assumed, the difference which occurs in the relative force of the reflective action of the moon with that of her *distance*, in reference to the sun and earth. And finally,—(which it may be added can only be explained on the principle of reflective action,)—the marked difference observable between the tides at the periods of the equinoxes, when reflective action, as at the lunar spzyges, is greatest in the *annual circle;* and at those of the solstices, when, as connected with the latter, it is least, or at its minimum of force, (as at the lunar quadratures,) sufficiently shows that the same analogy exists between the tides and the action in the annual circle, as between them and the actions in the lunar and diurnal; and that though all three are acting simultaneously on the atmosphere, their actions are perfectly distinguishable one from the other in their effects, not only on the temperature and weather, but on these the phenomena of the tides. And it is further not a little remarkable, as connected with the latter phenomena, that the number of their tides is the same; consisting as they do of *two* entire revolutions in each circle.

These views, however, will be admitted to increase in interest and importance, when it is considered that it is only by means of them, and of the species of independence which they go to show subsists between the meteoric actions in these circles, as of the individual connexion of each with particular classes of phenomena, that we are enabled, on scientific grounds, to account for the diurnal variations of the compass-needle, as being effects of the variations of reflective action in the diurnal circle; or the barometrical variations corresponding to the phases of the moon, which have obliged that acute observer, M. Arago, of the French Institute, to admit, that "*they are effects of some special cause totally different from attraction*, of which the nature and mode of action are unknown."* And that the anticipation of Mrs. Somervill, when she states, "that perhaps the day may come, when even gravitation, no longer regarded as an ultimate principle, may be resolved into a yet more general

* Dr. Wm. Prout, in his "Abstract of Observations on Atmospheric Air," page 568, observes that "*the weight of the air is usually heavier about the new and full moon;*" which will account for the tides being higher at these than at the opposite periods of the moon, For, as it is *the pressure* on the surface of its waters *in the interior*, which induces the tide-wave on the shores of the ocean:—at those periods of the moon when this pressure, with that of the air, is greatest, the tides on the shores of the ocean should be the highest; and *vice versâ*.

cause, embracing every law that regulates the natural world:"* may thus, even now, be considered as already realized.

I may further observe, while on this subject, that I think it highly probable, the meteoric influence on our seasons exercised by the actions in the circles traversed by the superior planets—when observation shall be directed to ascertain the fact—will be found to be equally distinct and distinguishable in reference to each, as in those of the three local circles already noticed. And that, of the three external planets, whose meteoric influence is assumed to be the most powerful, viz. Jupiter, Saturn, and Uranus;—as being that which embraces within its orbit the entire of the orbits traversed by the remainder of these bodies, and which thence may be said to compose the *cadre* or frame of the system it encircles, the Uranus is that which exercises the most extensive influence on our seasons.

And if from this the extreme verge of being connected with the system we inhabit, we turn to its grand source and centre, the sun:—his *movement of rotation* seems conclusive that, as the planets are to him, so is he to a *more distant centre*, viz. that he is but a member of some superior sideral combination. For, on no other principle than this of the

* See Mrs. Somervill's work "On the Connexion of the Sciences," page 415.

sun being dependent on a more distant centre, can his rotation—considered as being the effect of reflective action—be satisfactorily accounted for. Thus seeming to demonstrate, on scientific grounds—did we entertain any doubt to the contrary—that the same connexion, unity, and dependence subsists throughout the entire of the starry heavens, however illimitable, as in the system, or department of it, to which we more particularly belong. But in reference to the position or nature of the grand centre which serves, by its weight, to balance and unite such countless worlds,—who will pretend to say, or even to hazard so much as a conjecture?

In reference to the sun's not exhibiting *phases* similar to the inferior planets, or the moon, as should be the case, did his light depend on his connexion with a distant centre. This circumstance, I think, is chiefly owing to the *extent of his atmosphere;* which, similar to those of comets, from its superior magnitude as contrasted with those of the planets, instead of confining light as in the latter, to one of his hemispheres, has the effect, as in the former bodies, of completely investing him with this dazzling livery. And to which effect, it may be added, the extreme brilliancy of the solar light, being, as it is, of a different species to that of the planets, must be supposed materially to contribute.

"I do not know," said the illustrious Newton, a short time before his death, "what I may appear to the world, but to myself I seem to have been only like a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary; whilst the great ocean of truth lay all undiscovered before me." And this modesty of Sir Isaac Newton, as observed by his able biographer, Dr. Brewster, in reference to his great discoveries, "was not founded on any indifference to the fame which they conferred, or upon any erroneous judgment of their importance to science. The whole of his life proves that he knew his place as a philosopher, and was determined to assert and vindicate his rights. His modesty arose *from the depth and extent of his knowledge,* which showed him what a small proportion of nature he had been able to examine, *and how much remained to be explored in the same field in which he had himself laboured.* In the magnitude of the comparison," continues the doctor, "he recognised his own littleness." And why, it may be asked, do I, in this place, refer to the words of this great man, or to the explanation given by his biographer as to the cause of his modesty? Most assuredly, not from any motive so weak and childish as that of vanity; as no one can be more fully sensible than myself, how immeasurably I should lose by any comparison with him. But that, as the greater depth of his views enabled

him better than, perhaps, any other man of his time, to perceive how impossible it was to penetrate the veil which as yet hung over and concealed the sources of natural phenomena, not excepting even those which he attempted to explain; whilst, as he expresses it, "the great ocean of truth lay all undiscovered before him:"—that, on an occasion like the present, when, guided by more certain lights, a different view is taken of the fundamental principle on which his theory is based, than that given by him or others, I considered him the best authority to quote against himself; with the view of showing the little of certainty which he himself attached to the principle of planetary movement proposed by him. And how, indeed, should it have been otherwise with a man of the enlarged views and deep penetration of Newton, at a time when so little had been done in what may be denominated *the preliminary,* (and certainly the most difficult and indispensable,) *department* of such discoveries, viz. that of ascertaining by a long course of laborious experiment and patient observation, the first springs and principles in which natural phenomena have their source; together with the laws by which they are governed in their development. For, in the absence of the guides thus supplied, it were about the same to attempt exploring these departments of science with any prospect of success, as for a man in the dark to attempt tracing the figures on an Indian screen.

And yet, however palpable this impossibility on the part of Sir J. Newton, or of any other, in the then state of chemical and electrical science, to do more than hazard a conjecture in reference to the source of planetary movement, temperature, &c.—the fame of this great man, from being supposed identified with a theory which bears his name, and which, till modern inquiry has shown its futility, was thought to be infallible; is,—however much in contradiction with the object he proposed to himself through his long and glorious career,—become one of the most formidable obstacles to the admission of more correct principles. And this, notwithstanding the testimony borne by himself as to the little of certainty which he attached to the views he had taken of natural phenomena. The test of infallibility so long attached to the Newtonian principle of gravitation, is, as is known, that in all calculations it is found conformable to the law he proposed, viz. that its action is inversely as the squares of the distances;—as though it were possible for the propelling force which gives movement to the planets, be it what it may, to act according to any other.* And thus it has happened with the principle of universal gravitation, that being found right in this respect, it has

* Coulomb discovered that electrical attraction and repulsion (similar to gravity,) are *inversely as the squares of the distances.*—See Ure's Dic. of Chem,, page 405.

led to the belief that it must be equally so in every other; which, though totally erroneous, has served to silence all doubts as to its correctness; to the no small detriment of the cause of truth. For, as observed by Raynal, "on n'examine guère ce qu'on croit bien savoir; et c'est ainsi qu'après avoir propagé *les erreurs, les témoignages qui retardent l'observation, en prolongent encore la durée.**

The locality and real place occupied by gravity in the scale of physical causes, has, on the contrary, as I trust, been fully shown in the preceding pages. And that,—(by facts obtained from the variations of the tides in the annual and lunar, equally as in the diurnal circle of meteoric action, and barometrical variations corresponding to the phases of the moon, and as should be the case when not an ultimate cause,)—gravity itself, similar to all other derivatives, *varies in its amount* with the variations which occur in its source—*reflective action:* and also, (as anticipated by Mrs. Somervill,) that it can no longer be regarded as an ultimate principle, but one which resolves itself into this more general cause which embraces every law that regulates the natural world; as that, from its being altogether *local* in the sun and planets, gravity can have nothing to do with the principle of their movement; but that the latter, equally as the temperature and other local

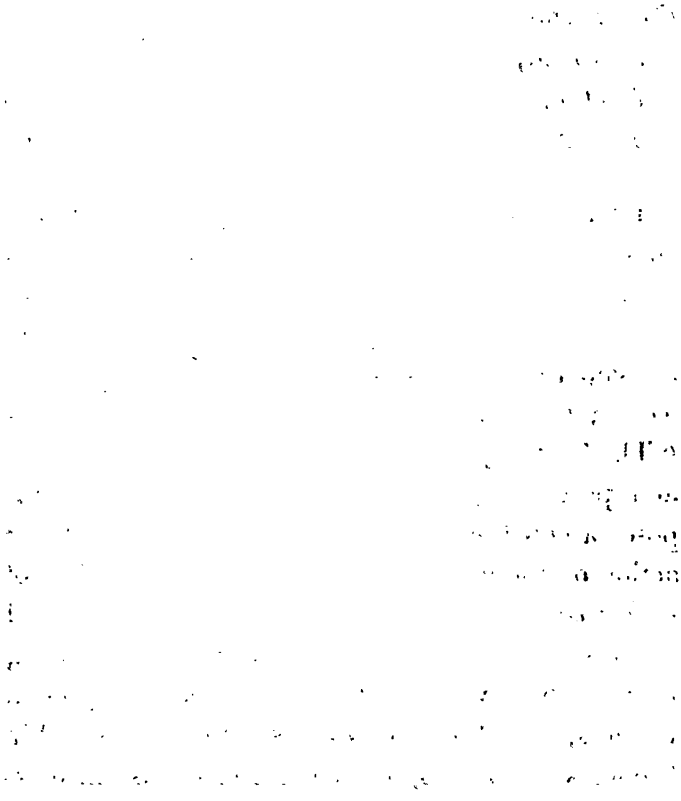
* Histoire Philosophique, tom. 6, page 40.

phenomena of these bodies, is, as being the only active forces of nature in the physical world, altogether referable to magnetic and electric agency, based on the principle of reflective action; thus, as I hope, finally disposed of these important questions.

And, were it possible to recall "the fleeting breath," and with it the illustrious Newton, to the scene of his former triumphs; and that he were in possession of the facts supplied by the rapid advances latterly made in what may be called the collateral branches of this department of science,—satisfied am I, that he would not only concur with me in this opinion; but that, in the spirit of that candour which is so characteristic of great minds, and alike superior to those low passions and prejudices which are no less the characteristics of small ones;—having weighed and considered this theory, both in its ensemble and details, he would be amongst the foremost to admit and subscribe to its general correctness. And that, in the feeling inseparable from seeing the grand object for which both he and so many other illustrious men had so long, so earnestly, and yet so ineffectually laboured, at length attained; and with it the dawn of a new era in science, (more prolific in important results to the whole family of man, than all those by which it was preceded,) already about to appear: that in the virtuous enthusiasm it inspired, he would, something in the words of Simeon, exclaim, "let thy servant depart in peace;

now that mine eyes have seen realized the long expected consummation of my fondest hope!" For, it was not without reason Helvetius observed, "que *c'est des profondeurs de l'imagination qu'on a jusqu'à présent tiré le systême de l'univers;* et que, si l'on n'a jamais que des nouvelles tronquées des Pays éloignés de nous, les philosophes n'ont pareillement que des nouvelles tronquées du systême du monde." And that "avec beaucoup d'esprit et de combinaisons, ils ne débiteront jamais que des *fables, jusqu'à ce que le tems et le hazard leur aient donné un fait général auquel tous les autres puissent se rapporter.*"* But, unfortunately for the cause of science and humanity, "L'homme de génie passe trop vite! et *ne laisse point de postérité:* and, perhaps, it were too much to expect the candour of Sir Isaac Newton from his representatives of the present day.

* *De L'Esprit.*—Paris edition of 1759, pag. 26.



METEOROLOGY.

SECOND PART.

COPY OF A PAPER

Explanatory of the Lunar Action of the Weather, presented, on the part of the Author, at the Meeting of the British Association for the Advancement of Science, held at Dublin, in 1835.

Esteeming, as I do, the question—so much discussed of late—as to the existence and nature of a lunar action on the weather to be one of so much importance to science, that, on its solution alone, may be said to depend that of the true theory of the world; and having in a lately published work,—"The Anatomy of the Seasons, Weather-Guide Book, and perpetual Companion to the Almanac,"—proposed a new theory of temperature, and of the lunar action on the weather, founded on the principle of *reflective action* reciprocally between the sun and planets;—and for the details of which, I must beg to refer to the work itself. The object of the present paper is, to add some new views to those advanced in the work alluded to, in reference to the assumed ex-

istence of such an agency, as in proof of the principles on which it is founded; and, it is hoped, of a nature so satisfactory and conclusive, as must convince the most sceptical, that this, the question, as to the existence and nature of a lunar action on the weather, is at length finally determined, and a term necessarily put to all further doubt on the subject. I may add, that the supposition as to the earth and its atmosphere being a *thermo-electric* combination put into action by the sun and planets—at present so generally accredited—is that on which the theory of meteorology proposed by me is founded: and that it is in consequence of the greater proximity of the moon than of the other external agencies of the solar system, and to the more frequent changes in its position in the ecliptic, in reference to the earth and sun, on which is founded the assumption,—that the moon exercises an influence still more marked and considerable than the other planets, on the temperature and weather of our seasons, equally, as on the phenomena of the tides. . . . . .

And as, from the intimacy of the meteoric action of the earth and moon on the seasons and weather, that, in order to form a correct idea of either action, it cannot be considered without reference to the other; and that, owing to the most important meteoric effects throughout the year,—whether as refers to the temperature or violent class of atmospheric phenomena,—being connected with the *sol-*

stices, or the lunar *syzygies*;* as that these are likewise the periods which constitute the mean limits respectively to the *opposite tendencies* of meteoric action in the atmosphere—whether to heat or cold—to drought or to humidity—the former, or solstices, as connected with the annual, and the latter, as connected with the lunar, may, with some propriety, be denominated the *meteoric poles* of these the annual and lunar circles. And as, on a correct knowledge of the changes which take place in the *tendence* of meteoric action in the atmosphere, as connected with the annual and lunar circles,—so much of all that is practically useful in the science of meteorology depends. Thence it is, that, from the article on this subject in my published work,—as connected with the lunar circle,—being less perfect than what, from the importance of the subject, it should be; and from its being that likewise, which furnishes the least equivocal proofs as to the nature and extent of the lunar action on the weather;—I thought right to select it as the subject of this paper. And as the tendence of meteoric action in

* The principle of *magnetic revulsion* in the atmosphere, connected with the change of position in the *acting* magnetic poles of the earth and moon at the periods of the lunar syzygies, connected with the elliptical movement of the moon; to which the occurrence of these phenomena at the latter periods is to be ascribed, as noticed in the preceding part; had not as yet been suspected when this paper was written.

the atmosphere as connected with the lunar circle, notwithstanding its changing continually with the change of the seasons, is fixed and determinate throughout the year:—my first object shall be to point out the tendence of meteoric action in the lunar circle as connected with the different parts of the annual: and finally—together with the causes,—the periods of the year in which the natural tendence of the lunar action on the weather is most subject to be deranged, and those during which it is the least liable to change or variation; so as that the different bearings of this very complex subject, may appear in a clear and perspicuous point of view.

Thus, in the first place, the tendence of meteoric action in the atmosphere, as connected with the lunar circle appears, as refers to its opposite divisions, to change *half-yearly* with that of the earth's position in the ecliptic, i. e. from the period of the winter to that of the summer solstice;—and from the latter to the former, alternately. During the former, or from the winter to the summer solstice,—the tendence of meteoric action in the atmosphere, as connected with the lunar circle, is as follows, viz. From three days before the period of *new moon*, or the setting in of the *positive* meteoric tide of this quarter, to that of the setting in of the succeeding positive tide of *full moon*, the tendence of the lunar action on the weather, is *to drought:* and during the same period—from the setting in of the positive

tide of *full,* to that of the commencement of the positive tide of *new moon,*—the tendence of the lunar action on the weather is to *rain* and *its accessories.* Contrary, however, to this,—from the period of the summer to that of the winter solstice,—from the setting-in of the positive tide of *new,* to the setting-in of the positive tide of *full moon,* the tendence of the lunar action on the weather is *to rain;* and during the remaining half of the lunar circle, the tendence of this action is *to drought.* But a circumstance not a little remarkable is, that, whereas these tendencies of the lunar action on the weather as described, are strongly marked *immediately after either solstice,* and again, for some time, *preceding these periods;*—in proportion as, on either hand, we approach the *equinoxes,*—the order in the tendence of meteoric action in the atmosphere, as connected with the lunar circle, gradually undergoes a change; till finally at, suppose, the *vernal equinox,* this order becomes *reversed:* and as, being a consequence of this, the equinoctial phenomena in spring usually occur at or about the period of *new moon,*—and those connected with the autumnal equinox at the opposite season of the year, at or about the period of *full moon:*—the preceding order, in both cases, being again restored immediately after the equinoctial phenomena, and thence continues to the approaching periods of the solstices.—Thus, as there are *six moons* from either solstice to the opposite;—

the tendence of meteoric action in the atmosphere during those from the winter to the summer solstice, generally, (*i. e.* circumstances connected with particular latitudes and localities, as regards the weather excepted,) appears to be as follows, viz. In the lunar circle which succeeds immediately after the winter solstice, the tendence of meteoric action in the atmosphere during its *first half*, is *to drought;* and during the opposite or remaining half, *to rain.* During the succeeding moon, these the meteoric tendencies in the weather as connected with its opposite divisions, appear to be nearly equally balanced; and to be determined to either, chiefly by the existing tendence—whether to drought or rain—of the season. During the *third moon,* or that which occurs about the equinox, the preceding order, as noticed, becomes reversed; as the equinoctial phenomena in March, usually occur at the period of *new moon.* In the following moon, or that which usually marks the period of the *N. E. wind,* the preceding order becomes again restored—the tendence of the weather during its first half being *to drought,* and during the latter half *to rain.* During the succeeding, or *fifth* moon, the same order in reference to the tendence of meteoric action in the atmosphere, as during the preceding continues. And finally, as connected with this division of the year,—during the following moon, which extends to the vicinity of the summer sol-

stice,—this order, as described, is still more strongly marked (than in that by which it was preceded) in the weather;—its commencement being usually *dry*, and accompanied with a marked rise of temperature; and the weather towards its close, being not only *wet*, but attended by some of the most violent gales of the season. Different from this, however, in the *first moon* after the summer solstice,—the tendence of the weather from its commencement to *full moon*, is *to rain:* as during the remaining half *to drought*. During the following moon, the tendence of the weather, as at the opposite season of the year, appears to be equally balanced, as connected with its opposite divisions,—it being the dominant tendence, as connected with the season—whether to drought or rain—which, during its continuance determines the weather to either. In the following moon, (the *ninth* of the year,) the order of meteoric tendence in the atmosphere, as in spring, becomes *reversed:* and as being a consequence, its setting in is, in general, attended by *dry weather:* and the equinoctial phenomena,—as noticed—usually occur at or about the middle of its course, or period of *full moon;*—and I may add, that the period of *new moon* in this, or as sometimes happens if they have not sooner occurred, in the moon by which it is succeeded,—being thus accompanied by *fine weather*, may be considered as a certain indication of the approaching occurrence of the equinoc-

tial gales at the succeeding period of full moon. In the *fourth moon* from the solstice, provided the equinoctial phenomena *have* occurred during the preceding moon,—the tendence of meteoric action in the atmosphere, as in the first moon after the solstice, becomes again restored;—the tendence of the weather during its first half being *to rain:* as thence to its conclusion, *to drought.* During the succeeding moon (the eleventh of the year,) the preceding order of meteoric tendence in the weather continues;—except in those situations where—from the peculiar nature of the *localities,* combined with a preponderating tendence of an opposite kind in the season, interfere to derange it. And finally, the concluding moon of the year, which thence approaches to the period of the winter solstice, is sure to develope in a still more striking manner than the preceding, this the assumed order in the tendence of meteoric action in the atmosphere:—the chief period *of rain,* equally as *of storm,* during this moon, occurring at the period of its setting in, or immediately preceding *new moon*; and that of its *greatest drought,* as *fall of temperature,* being at, and subsequent to its *second quadrature,* or conclusion.

Now, were the assumed influence of the moon on the weather throughout the different seasons of the year, as here pointed out, *always constant* and invariable, the business of calculating *in advance* its approaching changes, were at any time comparatively

easy. But unfortunately—however desirable the latter—there are various causes which, almost continually, interfere, in deranging to a certain extent, the operation of these the natural tendencies of the lunar action on the weather. And, of these, the first I shall notice are such as are connected with the circumstances of *latitude* and *locality*—already alluded to—and of which the following facts of recent occurrence may serve to convey some idea.—Thus, as refers to the occurrence of *storm* at the period of *full moon*, from towards the period of the autumnal equinox, to the winter solstice; and, properly speaking, connected with the equinox.* In the summer of 1834 we find that, as early as the 20th of July, (being the period of *full moon*,) a hurricane occurred at Davis's Straits, which, according to the report of Captain Stratton, of the whale ship, Ulverstone,—as stated in the papers, caused the breaking up of all the land ice in those seas. Again, a dreadful thunder-storm (as reported in the London *Morning Post*, of the 26th September, 1834,) occurred at the Hague, attended with loss of life, &c. on the 17th of September, (the period of *full moon*.) Third, the destructive gales of the 15th, 17th, and 18th of October, (*full moon* having occurred on the 17th,) by which, as reported in the newspapers, from Lloyd's lists, no less than fifty-six

* See preceding Note.

ships were wrecked on the coasts of England and Holland. And finally, the destructive thunder-storm and water-spout, attended with loss of life, &c. which occurred at Gibralter, on the night of the 17th of November, (as reported in the London *Globe* of the 22nd December, 1834,) *full moon* having occurred on the 16th, or day before.* Thus showing,

* To this list of storms as connected with the meteoric action of the moon from after the period of the summer, to the winter solstice, may be added one of a much more recent date, viz. that which occurred in the Channel on the afternoon and night of the 29th July last, (full moon having occurred on the 28th, or day before,) and of which, happening to be on board one of the London steamers from Dublin, at the time, I was a witness;—the crew unanimously declaring, that nothing equal to it had occurred since the preceding March. And of which from the losses it occasioned in the neighbourhood of Liverpool, the following account appeared in the London *Weekly Dispatch* of the 7th August, 1836:—"*Melancholy Shipwrecks, Liverpool.*—On Friday evening, between seven and eight o'clock, a storm of wind and rain broke over the town. The wind, which had previously been blowing gently from the south, now began to blow with such violence from the N. W. by N., that in a short time it assumed all the features of a hurricane," &c. The account then proceeds to say, that the John Welsh, from Savanilla, on the Spanish main, and the William, from Dublin to Chester, were wrecked on the banks during the night;—fourteen persons having perished out of the former; and all on board the latter ship.

From the commencement of this moon, indeed, on the 13th of July, the rains, occasionally accompanied by gales of wind, had been frequent; but in point of violence, not at all to be compared to the gale on the night of the 29th; and which, on the principles

as would appear, that in proportion as with the advance of the season, an approach to *the same degree* in the dominant action, as connected with the *annual circle,* was transferred from the higher to the lower latitudes, and was thus encountered by the lunar action at the period of *full moon*—a similar developement of the same species of meteoric action in the atmosphere of our hemisphere took place, along the descending scale of latitude, in the direction of the tropic:—a circumstance, it may be observed, not a little curious, and deserving of notice. Another source of derangement in the effects on the weather, induced by the variations in the tendence of meteoric action in the atmosphere, as connected with the lunar circle,—will be found in the circumstance that,—as all the leading phenomena of the atmosphere connected with the *changes of the seasons,*—such as the periods of the opposite extreme degrees of heat and cold in summer and winter,—the occurrence of the equinoctial phenomena in spring and autumn; the setting in of the *N. E. wind* in spring, &c. *have each their fixed and determinate places in the annual circle.* When—as not unfrequently happens—that the lunar action of *a contrary tendence* to that which is proper to the de-

assumed, would show that the *cold of winter* during this period in the southern hemisphere, had been more severe than during the preceding years;—a circumstance which a short time only will be sufficient to clear up.

velopment of these phenomena, occurs at the periods when they should occur, and not the opposite of *conformable action of the moon*:—the consequence is, that, owing to the conflicting of such opposite tendencies in the atmosphere on these points of the annual circle,—the periods of the occurrence of these phenomena, both as connected with the latter, and the lunar circle, become more or less altered and deranged, proportioned to the resistances.

But a still more influential cause in deranging the natural effects of the lunar action on the weather during the greater part of the year, will be found to have its source in the changes which take place in the extreme degrees of temperature, as in the seasons,—equally as in the periods of occurrence of the equinoctial phenomena in different years; which I shall now proceed to notice. And, in order to this, it becomes necessary, in the first place, to commence with the *solstices*, considered as being the true meteoric poles of the annual circle; and further to observe, that the points on which, subsequent to the solstices, and at about the same intervals of time from the latter,—the opposite extreme degrees of heat and cold in summer and winter occur, may, in like manner, be denominated *the poles of temperature*. In turning to the points of the annual circle which—on the opposite sides of the solstices to those indicated as being the points where the opposite extreme degrees of annual tem-

perature occur, or at about a month preceding the former periods;—we shall find the points where the existence, equally as the nature and extent of the lunar action on the weather, are the most uniformly as clearly expressed; and which thence—as in the preceding cases—may, with propriety, be denominated *the meteoric poles of the lunar action on the weather*, as connected with the annual circle. For as, in consequence of the changes which take place in the temperature and seasons of different years, and in the periods of the equinoctial phenomena; that, during the seasons when these variations in the temperature, &c. occur; they must necessarily induce corresponding variations in the effects produced by the lunar action on the weather. It will follow, that it cannot be before we arrive at the periods of the year noticed, or those which—on either hand—from after the equinoctial phenomena in spring and autumn, extend to the solstices,—that we can expect to find *an equal and permanent action in the annual circle, such, as would uniformly exhibit without variation, either the nature or extent of the lunar action on the weather.*

Thus, to revert to principles: the tendence of meteoric action in the atmosphere, from the winter to the summer solstice, as connected with the lunar circle, being, as stated, from the period of *new* to that of *full moon, to drought;* as thence, to the commencement of the ensuing lunar circle, *to rain*

and *its accessory phenomena:* the moon which commences in May, and finishes in June, previous to the solstice, will, in a more striking manner than in the moons by which it has been preceded, be found to set in *with drought*, and, in general, with a considerable *rise of temperature*, (being illustrative of the *calorific action* of the moon on the temperature at the periods of the syzygies, when, as in the present case, not deranged by the currents of the atmosphere, or the occurrence of rain;) and, during its latter half, but more particularly towards the *going out* of this moon, that it will be found accompanied by *rain and storm*. And as the tendence of meteoric action in the atmosphere from the summer to the winter solstice, as connected with the lunar circle,—(as contrasted with the preceding half-year), —becomes reversed. Thus the moon which commences in November and concludes in December, previous to the solstice, will likewise, in a still more striking manner than in those by which it has been preceded,—be found to set in with *rain and storm;* and at its conclusion,—at, and subsequent to the *second quadrature*,—be found to go out *with drought* and *a marked fall of temperature*;—being illustrative of the *frigorific action* of the moon, in lowering the temperature, equally as the tides, at the periods of the *quadratures;* when, as in the instance noticed,—not deranged by the currents, or occurrence of the opposite species of meteoric ac-

tion in the atmosphere at the time.* And thence, I say, it is, owing to these the results, as described, being *constant* in those parts of the annual circle, that these moons may, with some confidence, be referred to, as the *test moons* of the present theory of meteorology.

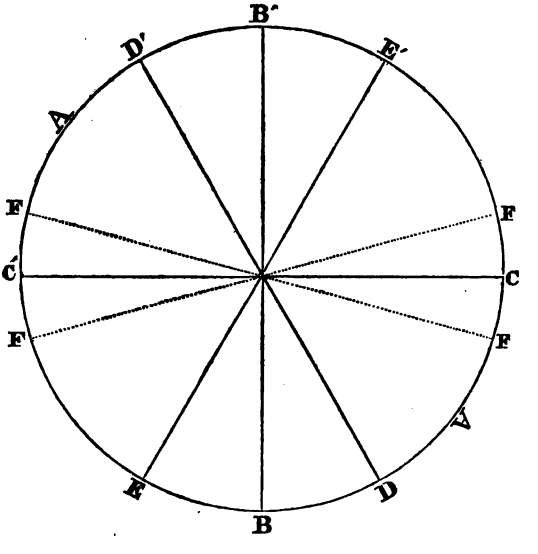
To conclude:—we are thus led to perceive—when found—that the same simplicity pervades the dispositions of nature in reference to the developement of her phenomena in the atmosphere, however complex in their sources, or evanescent in their duration,—as in the animal and vegetable kingdoms, connected as these are with the former. And that, in reference to the places occupied in the annual circle by what we have denominated the poles of temperature, and those of the lunar action on the weather, situated on the opposite sides of the solstices, or its true meteoric poles; and which, it may be added, are all permanent in reference to these the positions they occupy:—the same analogy exists, as between the opposite magnetic poles of the western and eastern hemispheres of the earth; situated, as the former, at equal distances on either side the poles of the earth's rotation.

The better to show the positions occupied by the

* For further particulars explanatory of the circumstances here noticed, equally as other parts of this paper, it is necessary to refer to Chap. 18 and 20 of the preceding Part.

points alluded to, as connected with the seasons; I am induced to present them in the subjoined diagram of the annual circle.

Diagram of the Annual Circle.



Let the circle A A represent the year; B B′ the line of the solstices; B the winter and B′ the summer solstice; the axis C C′ the line of the equinoxes, C the vernal, and C′ the autumnal equinox: D D′ will show the positions occupied by the opposite extreme degrees of temperature: and the extremes of the line E E′ the points where the lunar action on the weather, as described, is assumed to be always constant and equal in its results: the po-

sition of each of these lines in the annual circle being permanently fixed and unalterable. The dotted lines F F, F F, are intended to show the range of variation which, in different years, takes place in the periods of occurrence of the equinoctial phenomena in spring and autumn.

Concluding Observations of the Second Part.

I had, shortly after presenting this paper to the Association, prepared some further observations connected with the subject of the lunar action on the weather, and subsequently collected some additional facts, in reference to the assumed connexion of the lunar action at particular periods, with the occurrence of storms, (chiefly derived from instances in this class of phenomena which occurred during the winter of 1835-36,) and previous to my entering on the First Part of this work; which were intended to be added to it by way of supplement. But as, on examination, I find the greater part of these observations have already found their way into the preceding pages; and that such as have not, could, if inserted add but little to strengthening the case, in reference to the existence and nature of the meteoric action of the moon, already made out. In order, as much as possible, to avoid repetitions, I think it better, on the present occasion, to omit

giving them publicity in a distinct shape. For if the case thus made out, be not thought sufficient to induce a rally amongst the friends of science in these countries, with the view of setting on foot a society having for object to give to these discoveries the weight and consideration they are assumed to merit; (as being the sole means of making them practically useful, or of giving to them any further developement of which they may stand in need,) any thing further in the way of observation that were advanced by me in this place on the subject, could not possibly effect; and consequently my doing so, were little better than to labour without object.

As being the only effectual means however, of giving immediate operation to these discoveries by the general diffusion of information connected with them, to which it would lead:—the better to show the necessity which exists for the formation of a meteorological society, from the annual sacrifice of life and property, even amongst those engaged in the fisheries on the coasts of these islands, which the slightest acquaintance, on their parts, with the rudiments of meteorology, might in most cases be the means of preventing; I am induced to notice the storm which on the 18th of November 1835, caused such ravages on the northern coast of Scotland, connected as it was with the change of the moon, the latter or *new moon* having occurred on the 20th,

as may be seen by reference to the almanac: and moreover, from its having been preceded and announced a few hours previously by an *aurora borealis*:—which circumstances combined, at this advanced period of the season, could have left no doubt as to the proximity of the impending danger, had but the unfortunate sufferers who fell victims to it, had the slightest knowledge on these subjects. The published account of this gale, extracted from the *Leinster Independent*, of December, 5, 1835, is as follows,—"*The late storm—forty-eight lives lost.*—The Scotch provincial papers are filled with the most lamentable details of the effects of a violent storm, which appears to have been general on the northern coast of Scotland, on Wednesday morning, the 18th ult. The previous night was clear and calm, and *the aurora borealis more than usually brilliant*. The morning was equally fine, with a mild breeze from the southward, when about half-past ten o'clock, it veered suddenly to the north, and in a short time blew a perfect hurricane. A great number of fishing boats were overtaken by the storm, and notwithstanding the most experienced seamanship on the part of the crews, were unable to survive the tempest."—Here follows an account of the loss of eight boats, and 48 men.—"In addition to the above awful catalogue several fishing boats are still missing, and there is much reason to fear that their crews have met a watery grave.

Several coasting vessels were totally wrecked." "The hurricane is said to have exceeded any thing of the kind ever remembered, unroofing houses, and driving slates and tiles before it like chaff," &c.

This requires no commentary. And if the prospect of putting a stop to, or greatly lessening the number of such melancholy catastrophes, proves not a stimulus sufficiently strong to the friends of humanity in these countries, to set about contributing to the diffusion of the knowledge obtained on these subjects, amongst all classes of seafaring men; it were idle to suppose that any thing that could be advanced by me on the occasion would be attended to.

METEOROLOGY.

THIRD PART.

METEORIC PROGRESSION,

Considered in its Connexion with the Changes of the Seasons and Weather.

"A serene autumn," observes Lord Bacon, "denotes a windy winter; a windy winter, a rainy spring; a rainy spring, a serene summer; a serene summer, a windy autumn: so that the air, on a balance, is seldom debtor to itself; nor do the seasons succeed each other in the same tenor, for two years together." The view of the seasons and weather here taken, equally as the line traced out for conducting inquiries connected with them, though to the ordinary observer it should not appear to contain in it any thing extraordinary; yet is one so necessary to be taken in investigations of the kind, that, even with the advantage of correct principles in other respects, it was impossible, except by means thereof, to make them (to the extent of which they were susceptible,) available.

In order to form a correct idea of this, it will be sufficient to observe, that though in the same locality no change in the mean temperature of the seasons during two years consecutively took place; and that in this as in other cases, it were expected that such sameness in the temperature would be productive of *similar effects* in the seasons; so far from this being the case, in reference to the latter—without taking into account the variation induced simply by the manner in which the opposite species of meteoric action in the atmosphere, connected with its opposite states of drought and humidity, succeed each other therein, as here designated under the title of *meteoric progression,*—all calculations in reference to the seasons of these years, would, to a certaint extent, be found defective. So influential, however, do I esteem the operation of this principle of meteoric progression, in inducing an approximation between the same seasons *alternately,* or every second year, that I think it goes far towards counteracting the effects which would otherwise arise from the ordinary changes which take place consecutively in the mean annual temperature. As the latter, however, is occasionally so considerable as entirely to merge the influence on the seasons which arises from this cause; it is only as refers to the ordinary years, or when the changes that usually take place in their temperature are less considerable, that it can be justly admitted to exercise such an

influence; and it is solely under this point of view I propose to consider it at present. Admitting, however, as is usually the case, that important changes in the seasons are induced by the operation of meteoric progression: considered as an element of calculation, the first thing to ascertain were, the number of years it would require to effect such a revolution in this order, as that at their expiration it would recommence as before; I shall first consider it in this respect.

Thus, the seasons of the year being in number limited to *four;* whereas, according to the order of meteoric progression, as here sketched by Lord Bacon, *five* were necessary to complete the revolution proposed; were it not that the phenomena of the atmosphere are limited to *opposite kinds*,—the consequence would be that, till these the *odd*, or fifth quarters, returned anew to the same positions in the annual circle which they occupied at first, *i. e.* every *fifth year*, a perfect return to the same order of meteoric progression in the seasons could not take place. Owing, however, to the circumstance that the entire phenomena of the atmosphere, as connected with the seasons and weather are limited to *opposite classes*, *i. e. drought* and *humidity*, to one or other of which these the phenomena of the seasons must, of necessity, belong. It will thence become apparent, that it can only be from *an excess* of either species of meteoric action, in the seasons

of the same year, that a derangement in the order of meteoric progression, of the kind noticed by Lord Bacon, could take place.

And thus that, during years when, within certain parallels, and localities, a derangement in the order of meteoric progression of the kind mentioned, did occur; under the influence of opposite circumstances, in other regions of the same hemisphere, quite a different order of meteoric progression from the former would take place. And finally, that, in other regions of the hemisphere, from their being under the influence of circumstances still different from the cases supposed; or where the acting causes which determine the opposite species of meteoric action in the atmosphere, were equally balanced one to the other in the seasons, that no derangement of the kind would occur; but an entire revolution of meteoric progression be completed within the year. Showing, as these facts are calculated to do, the important influence exercised by latitude and locality, on the entire annual round of meteoric phenomena.

And as in the distribution of meteoric action, as connected with the annual circle, a preponderance of *drought* generally occurs in those countries which are situated in the higher latitudes, equally as in the opposite parallels of our hemisphere; and consequently that it is only in the intermediate regions, and in insular situations, as in these islands, where

a redundance of the opposite kind, or of humidity, in the seasons, occurs; thus it is only in the latter class of localities, where *meteoric progression* induces the changes in the seasons noticed by Lord Bacon.

With us, however, this influence is very considerable, as will appear by a reference to the seasons of 1833 and 1834. Thus the *winter temperature* of those years, (which may be considered as the *basis* of the phenomena of the succeeding seasons,) being nearly the same: the winter of 1832-33, with a temperature equally mild as that of 1833-34, was comparatively *dry* and exempt from storm: it was succeeded by a mild spring; a rainy May and June; a *long interval of drought* during the months of July and August, up to the period of the setting-in of the equinox, about the first of September, followed; and to the latter succeeded the memorable autumn and winter of this year, which for rain and storm in these countries has had but few equals. The temperature, however, being equally mild as during the preceding winter. The following spring, and the commencement of the summer of 1834, had nothing strikingly different in the weather from those of the preceding year; but the change which took place, subsequently, was sufficiently remarkable. For, whereas the greater part of July and August, in 1833, was, (but more particularly in Ireland, whose climate is so peculiar,) an interval of drought; this period in 1834, was one of almost *incessant rains;*

in so much, that the crops were, in many parts, completely laid by the latter. To this season of wet, a long interval of comparatively dry and very warm weather succeeded, to the period of the setting-in of the equinoctial phenomena in the middle of October. And, finally, the latter was followed by the dry, mild, and pleasant winter of 1834-35; which, in all respects, with the exception of the temperature, was the contrast of the winter of the preceding year. Thus showing that the changes in the weather induced by the *irregularity of meteoric progression*, are chiefly connected with the solstices, or seasons of summer and winter.

Notwithstanding, however, as regards *the weather*, that it is during the summer and winter months the variations induced by the irregularity of meteoric progression are, as stated, most apparent and considerable; such is not the case as refers to the *violent class* of atmospheric phenomena or chief storm periods of the different seasons of the year:—the variations in the occurrence of which, as appears, are but little affected by the variations of the weather about the periods of the solstices; whereas quite the contrary is the case at those of the equinoxes. Thus, to refer to facts, in 1833, the storm period connected with the vernal equinox, occurred on the 20th of February; the second, or that of the summer progression quarter, from the 11th to the 14th of June; the third, or that connected with the autumnal equinox, on the 31st of August; and

the fourth, on the 29th November. The latter, as already stated, having been succeeded by a very wet and stormy winter and spring. In the succeeding year, of 1834, however, the storms connected with the vernal equinox did not set in till the 28th March, being thirty-six days later than on the preceding year; whereas that in the early part of summer, occurred about the same period, viz. on the 14th and 15th of June: again, however, as in the spring, dissimilar from the prceding year, the storms connected with the autumnal equinox, did not set in till the 16th and 17th of October, being forty-six days later than in 1833; and, finally, the fourth storm period, as on the preceding year, set in on the 29th of November, and continued to the 2nd of December; having been, as stated, succeeded by a comparatively mild, dry, and pleasant winter. And as, in the succeeding spring of 1835, the equinoctial phenomena again, as in 1833, set in as early as the 27th of February, (being the period of new moon;) as in the autumn of this year, on the night of the 9th September, two days subsequent to the period of full moon; we are thus warranted in concluding, that while the chief storms connected with the solstices are nearly *stationary*, in the periods of their occurrence, notwithstanding the variations which take place in the weather of these seasons; those connected with the equinoxes, on the contrary, vary almost continually in the succeeding years: but

that, notwithstanding the latter circumstance, a strict relation between the periods of the occurrence of these the equinoctial phenomena in the spring and autumn of the same year, appears to exist; as the differences observable in this respect, are usually occasioned by the variations which occur in the periods of the lunar action at these the opposite seasons of the year, at which they develop themselves. I may add, that when an interruption to this order occurs, viz. when the equinoctial phenomena in spring occur about the same period of the season during two years consecutively, it would seem to indicate the approach of a marked change in the weather of the succeeding seasons, from those by which it was preceded, whether to increased heat or cold.

Indeed it is in this latter point of view that the periods of the occurrence of the equinoctial phenomena appear to have the strongest claim on our attention. For, as the equinoctial gales in spring may be considered as marking the period of the annual *ascent* or preponderance of the *electric* action of the sun on the atmosphere, over that of its opposite, the *magnetic;* as at the opposite periods of the year, the equinoctial gales in autumn mark that of the ascendancy of the latter over the former action. And that on the principle of *increased length of exposition,* as connected with the solar action: when these phenomena occur early in the spring, the temperature of the succeeding summer, (other circum-

stances being the same,) should be proportionately higher than when they occurred late in the season. And, on the same principle, that when these phenomena occur early in the autumn, the temperature of the succeeding winter should be lower than when they occurred late. And as from the connexion observable between the period of the occurrence of these phenomena in spring and autumn, that on years when they occur early in spring, though the temperature of the succeeding summer may be expected to be high, yet that the early setting in of the equinox in autumn, is likely to induce an early break in the weather, by the setting-in of the autumnal rains. Thus it would follow, that on years when the equinox sets in early in spring, though an abundant return from the ordinary winter and spring crops may be expected; this does not follow in reference to those, such as maize, the produce of the vine, &c. which arrive to maturity later in the year; and whose produce must necessarily be injured by the early setting in of the autumnal rains; and as being a consequence, if these principles were correct, the seasons which were the most favourable to the former class of crops, should be those least so to the latter. And as from its more northern position than the other wine countries of Europe, the vintages in France, more than elsewhere, should be expected to afford illustrations of these principles; by referring to those of the last three years, we may

probably find in them the illustration required.—Thus, in 1833, the equinox set in as early as the 20th of February; and though the harvest of this year was abundant, the vintage in France was not remarkable either for quantity or for the quality of its produce. In the year 1834, the vernal equinox, on the contrary, did not set in till the 28th of March; and though, as noticed, the months of July and August were unusually wet, the vintage this year, not only in France but in the other wine countries of Europe, was one of the best that had occurred for a number of years. Again, in the spring of 1835, the equinox set in as early as the 27th of February; and, as is known, the vintage of this year, both in France and Portugal, proved very generally a failure: which may serve to show the intimate connexion subsisting between the period of the setting-in of the equinox in spring, and the succeeding seasons of the year.

It may be further observed, that the actions in the annual and lunar circles, as connected with the weather, are so perfectly analogous, that the effects of meteoric progression must be expected to extend to the latter equally as to the former. Indeed, these are at times so strongly marked in the contrasts which at the same periods of succeeding moons frequently occur in the weather, that it is impossible not to see and be satisfied that such is the case. And the seasons when these the effects of

meteoric progression, as connected with the lunar action, are the most apparent, are those which extend from the opposite solstices to the ensuing periods of the equinoxes:—the meteoric action of the moon during the opposite seasons of the year, or from the equinoxes to the solstices, owing to the cause stated in the preceding paper, being less liable to variation, and necessarily more constant in its effects.

And here it may be right to notice, that were the meteoric action of the moon, in its range, similar to the seasons, *confined to the atmosphere of either hemisphere of the earth,* we might expect it to be much more clearly defined, and determinate in its effects on the weather. But as, similar to the solar action, it is not exclusively confined to the atmosphere of either, but extends at once to both; and that the seasons, as the opposite actions of the sun, on which the effects of the lunar action depend, are continually opposed to each other in the atmosphere of the opposite hemispheres. Thus it is that the effects of the lunar action on the weather in either hemisphere, are, as stated, continually in opposition to the effects induced by it at the time in the atmosphere of the opposite. And if, as assumed, the state of the temperature with us, whether in winter or summer, enables us to judge as to the relative temperature of the seasons, in the southern hemisphere:—mild winters with us, being indicative of warm sum-

mers in the opposite hemisphere; and *vice versâ*, as shewn by the cold and rainy summer of 1829, when the winter cold in the southern hemisphere, as experienced in the colonies of New South Wales, was greater than had been known for a number of years. In like manner, I say, it is, that from the effects of the lunar action on the weather with us, being, throughout the year, continually in opposition to those induced by it in the atmosphere of the southern hemisphere, thus,—similar to the solar action—it produces directly opposite meteoric effects simultaneously at the opposite extremities of the earth. From this it follows, that an intimate connexion subsists between these actions;—and that the state of the temperature in the southern hemisphere, both in winter and summer, instead of being as might be supposed, neutral, may, on the contrary, be said, not only to affect the existing temperature with us, but materially to influence the effects produced by the lunar action on the weather of our seasons.

From every thing connected with the temperature and weather, however, being *collective*; and, at the same time, based on the simultaneous operation of opposite principles, which alternately change and supplant each other in the seasons at determinate periods. Thus we are enabled to account why the *tendence* of meteoric action in the lunar circle changes, with the solar action, from either solstice

to the opposite, as noticed; and in like manner why the equinoctial phenomena cannot develope themselves at the same, but at opposite periods of the moon, in spring and autumn; owing to the opposition of the actions in the opposite hemispheres, and the impossibility which exists for *the same species* of meteoric action being induced by *the same lunar action*, in both. Which latter I esteem to be so indubitably the case, that the state of the weather with us at, suppose new, or full moon, at any period of the year, enables us with every degree of certainty to know the existing state of the weather within the same parallels of the southern hemisphere at the time. Which, it will be admitted, is an extension of knowledge in this department of science, far beyond the very limited range to which during so many centuries it has been confined, or to which, up to the present, it was thought possible to carry it.*

Thus, to revert to the annual circle:—owing to the *irregularity* of meteoric progression in our seasons, *the same periods of succeeding years*, will usually be found to present *contrasts* more or less considerable in the weather; and the seasons every second, and probably still more, every *fifth year*, on

* It may be right to notice, that this paper having been written several months previous to the preceding Parts, some of the observations will be found to have been already anticipated in the latter.

the contrary, will be found to show an approach to the same kind of weather:—the circumstance of mean temperature not being materially different. Insomuch, that, by keeping in view the principle of an *equilibrium* between the opposite kinds of meteoric action in the seasons with which we commenced this article, and which is sure to come round and be restored about the periods indicated: thus, to the attentive observer, *the past,* will always be found to supply in this respect, the most unerring guide to *the future;* as regards the nature of the approaching seasons, and changes of the weather.

Having thus brought to a close the task (long since entered on,) of exploring the labyrinths, and investigating the sources of meteoric action; and, as I trust, shown the identity which, to a certain extent, exists between the latter and astronomical principles, equally as those connected with the entire round of the physical sciences; together with the advantages—more or less considerable—which the whole of the latter must derive from the increased light thus obtained. Considering meteorology under the double point of view connected with its theory and practice,—as it was impossible with any attention to perspicuity to mix up the latter with the former; thence the division in the manner

of treating the subject here introduced; the first or theoretic part being to a certain extent defective, without the addition of the two latter by which it is succeeded. And thus it is,—as being the connecting members, and natural divisions into which the subject resolves itself,—that though each of these parts has its use, this does not prevent but that, in point of interest, the first is that which chiefly claims attention; from its being according to the views and principles there taken or laid down, that the theory proposed must be judged of; and consequently, by which it must either stand or fall. And, notwithstanding the attention that has been paid in the preceding pages, to treat of all the leading points connected with meteorology; yet so ample is the field it presents, that, notwithstanding the partial change of principles introduced,—many of the views taken in my preceding publications are not only still applicable to the theory as it at present stands, but are in no slight degree requisite, in order to the better understanding of the subject.

And, it may be observed, as not a little curious, that perhaps the most conclusive proofs of the correctness of this theory—whether as refers to the movement, temperatnre, or other local phenomena of the earth, and planets, are derived from a principle which—from the imposibility of making it available by experiment,—seemed of all others the least likely to answer this end, viz. *magnetic action.*

And consequently these the discoveries connected with planetary magnetism, as detailed in the First Part, are those to which I attach the greatest importance; as the facts they have led to, are such as may challenge not only the strictest investigation, but defy the action of time to gainsay. And as previous to pushing my inquiries as connected with the subject of planetary magnetism to their present extent, I pointed out (in a letter bearing date the 9th of June 1835, to that distinguished astronomer, Sir William Hamilton, of the Dublin Observatory,) a circumstance connected with it which might serve as a test of the principle of *reflective action*, as recognised by the present theory, viz. the assumed change which, with that of the earth in the ecliptic, takes place in the position of the *magnetic equator;* and which, if so, must be greatest at the period of either solstice as contrasted with the opposite:—I think it right to notice the circumstance in this place, under the impression that, as connected with so important a subject to science, it may be thought worthy of investigation. For, notwithstanding the number, as palpable nature of the proofs, in reference to the connexion of magnetic action with the temperature, the formation of rain, and elliptical movement of the earth, already noticed; as in investigations of the kind, every thing practicable should be done to remove doubt, and make "assurance doubly sure:" a means so simple as this, and which

would cost so little labour or expense to ascertain, should not be allowed to remain unexamined.

Unfortunately for the cause of truth, there are but too many causes in operation, and which, whether owing to the weakness of our organization, to the vices of our constitution, or to other causes, it is to be feared will, to a certain extent, be always in operation, to counteract its salutary influence, and retard its developement: and which, in his disquisition on the Negroes, Raynal, with his accustomed eloquence and ability, sums up as follows, viz. C'est une preuve ajoutée à mille autres de l'incertitude de nos connoissances. Et comment nos connoissances ne seroient-elles pas incertaines et bornées? Nos organes sont si foibles, nos moyens si courts, nos études si distraites, notre vie si troublée, et l'objet de nos recherches si vaste! Travaillez sans relache, naturalistes, physiciens, chymistes, philosophes observateurs de tous les genres: et après des siècles d'efforts réunis et continus, les secrets que vous aurez arrachés à la nature, comparés à son immense richesse, ne seront que la goutte d'eau enlevée au vaste ocean. L'homme riche dort; le savant veille, mais il est pauvre. Ses découvertes sont trop indifférentes aux gouvernemens, pour qu'il puisse solliciter des secours ou espérer des récompenses. On trouveroit parmi nous plus d'un Aristote; mais où est le monarque qui lui dira; ma

puissance est à tes ordres ; puise dans mes trésors, et travaille! Apprends-nous, célèbre Buffon, à quel point de perfection tu aurois porté ton immortel ouvrage, si tu avois vécu sous un Alexandre! L'homme contemplatif est sédentaire, et le voyageur est ignorant ou menteur. Celui qui a reçu le génie en partage, dédaigne les détails minutieux de l'expérience; *et le faiseur d'expériences est presque toujours sans génie.* Entre la multitude des agens que la nature emploie, nous n'en connoissons que quelque-uns, et encore ne les connoissons-nous qu'imparfaitement. Qui sait si les autres ne sont pas de nature à échapper pour jamais à nos sens, à nos instrumens, à nos observations et à nos essais? La nature des deux êtres qui composent le monde, l'esprit et la matière, sera toujours un mystère.

* * La Religion, qui jette du dédain sur les travaux d'un être *en chrysalide* et qui redoute secrètement les progrès de la raison, multipliera les oisifs et retardera l'homme laborieux par la crainte ou par le scrupule. *A mesure qu'une science avance les pas deviennent plus difficiles ;* la généralité se dégoûte, et elle n'est plus cultivée que par quelques hommes opiniâtres qui s'en occupent, soit par habitude, soit par l'espérance bien ou mal fondée de se faire un nom, jusqu'au moment où le ridicule s'en mêle et où l'on montre *au doigt,* ou comme un fou ou comme un sot, celui qui se promet de vaincre une difficulté contre laquelle quelques hommes célè-

bres ont échoué. *C'est ainsi qu'on masque la crainte qu'il ne réussisse.* On a vu dans tous les siècles et chez toutes les nations, les études naître tomber et se succéder dans un certain ordre réglé. Cette inconstance cette lassitude ne sont pas d'un homme seulement. C'est un vice des sociétés les plus nombreuses et le plus éclairées. *Il semble que les sciences et les arts aient un tems de mode*" *

And, notwithstanding that certain parts of this picture may be overcharged:—we need not go back to the time of Raynal, in order to prove its correctness in others. For unfortunately *whim*, rather than sound judgment, but too frequently presides over the reigning fashion in science, equally as in dress. Thus, when accident brought part of Volta's or Galvani's circuit, I have forgotten which, in collision with the limb of a frog: a cool observer might suppose that this newly discovered property of electricity on the occasion, was not confined to the locality where the experiment was made, but extended throughout the scientific world, so promptly did it respond the shock! And what were not the wonders anticipated, and the conjectures hazarded, as to the results to which it would lead! Again, a gentleman at Paris some time since, in contemplat-

* Voyez—*Histoire Philosophique*, Tome Neuvième page 176 et suiv.

ing the splendours of the setting sun from one of the windows of the Luxembourg, was struck with something new in the diverging rays, and immediately out sprung the science of the polarisation of light; which has during some years fairly divided the suffrages of the learned with the steam engine. And yet, what are these discoveries, however ingenious, if tried by the test of usefulness? For the anticipations formed of the first have already passed their term, similar to those of animal magnetism;—the *central fire* of my old friend the late Baron Fourier of the French Academy, &c., &c.: and as to the last, the utmost that can reasonably be expected from it, is, to decide between the respective merits of the conflicting theories of solar light; and which though it may amuse, is not likely to lead to any thing further. It is true that, as connected with science, nothing can be considered as *small;* from things seemingly the most trivial having so frequently led to results the most important. And if the same anxiety in matters of importance, were always displayed by its cultivators, as on these light subjects, they might well be excused for indulging in those occasional wanderings. But has such been the case? And as, without co-operation in matters of the kind, the best things must, of necessity, fall still-born; having thus to the best of my ability contributed to increase the sum of our acquaintance with nature and

ther phenomena in the physical world;—let me indulge the hope that my efforts in the cause of truth —however they may have fallen short of my wishes —will not be allowed to become abortive, for want of that protection and support, which, by insuring their success can alone make them valid.

THE END.

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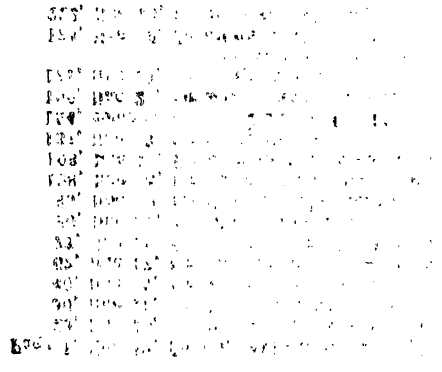

ERRATA.

Page 1, line 17, for on, read—in the atmosphere.
23, line 19, for whistlings, read—whistling.
30, line 21, for Sir Fohn, read—Sir John.
40, line 5, for les ciel, read—le ciel.
67, line 17, for converging, read—diverging.
73, line 28, for eclectrical, read—electrical.
80, line 28, for L'ui, read—L'uni.
85, line 9, for thenee, read—thence.
108, line 5, for operaticve, read—operative.
108, line 17, for ascrtained, read—ascertained.
137, line 3, for traees read—traces
154, commencement of line 6, for ile, read—cile.
166, line 25, for action, read—actions.
171, line 23, for syzygies, and quadratures, read—quadratures, or as connected with the syzygies.
174, line 9, for action, read—actions.
222, line 15, for tro ics, read—tropics.